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FOVILLE'S SYNDROME—RECORD OF A CASE

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IT is generally held that paralysis of the 6th nerve is of uncertain value as a localizing sign in cerebral disease. This is true only if the paralysis is peripheral in type and unaccompanied by paralysis of any other cranial nerve. When, however, the lesion involves the nucleus of the 6th nerve or the higher co-ordinating centres, the features of the resulting paralysis are such as to render exact localization possible. I submit the following case as an example of a pontine lesion with certain associated focal signs, the study of which may throw some light on the function of this complex region of the brain stem.

Case report

F. D., a male, age 56 years, consulted me because of failing vision and watering of the left eye.

History.—Three years previously, he noticed one morning that the left side of his face was twisted, and that he was unable to close the left eye. He was not aware of any seizure, and did not feel ill. A few months later the left eye began to water and was occasionally sore. Shortly afterwards he became unsteady on his legs and felt as though he was falling to the left, although he very rarely fell. About the same time his speech became indistinct and at times difficult to understand.

Family History.—There was nothing of note in the family history except that his mother died of a "shock." Patient was an only child.

Past illnesses.—He had the usual illnesses of childhood, and had influenza 5-6 years ago, but otherwise had been very healthy.

Present condition.—He had no headache, sickness or vomiting. Digestion was good, he enjoyed his food and was not constipated. Lately he had suffered from slight frequency of micturition, having to rise once or twice during the night to empty his bladder. He was breathless on exertion, but did not suffer from palpitation. He had suffered no impairment of power and had not noticed anaesthesia or abnormal sensations. On his own admission he was a confirmed alcoholic.

Examination

He had a good colour and was somewhat obese.

Nervous system.—Sense of smell was perfect. There was no sensory loss on the face or on the corneae. There was present complete paralysis and wasting of all the muscles of expression on the left side of the face. Hearing was slightly diminished on both sides. The tongue protruded quickly, straight and showed some coarse tremors. Sense of taste was diminished equally over the entire surface of the tongue, no difference being found between the two sides or between the anterior and posterior portions. Patient would not admit however that he had defective sense of taste.* Speech was hoarse and slurring and sibilants caused some difficulty. The palatal reflexes were present. There was no loss of power in the limbs; no areas of anaesthesia, or loss of bone, joint or muscle sense. The biceps, triceps and supinator jerks were present and equal; the ankle jerks were absent; the right knee jerk was present, but the left was absent. When he was asked to walk clock-wise around a chair he tended to go off to the left. He showed compass point walking. When he was placed with his feet close together with eyes closed, he tended to fall backwards and to the left. There was no past pointing or intention tremor. Dysdiadochokinesis and hypotonia were absent.

Cardio-vascular system.—The heart was not enlarged. The systolic blood-pressure was 148 mm. Hg and the diastolic 88 mm. No adventitious sounds were heard in the chest. The Wassermann reaction of the blood and the C.S.F. was negative. No abnormal constituents were found in the urine. A radiogram of the skull did not demonstrate any abnormality.

*I am of the opinion that the defective sense of taste was due to a local anaesthesia of the papillae from excessive doses of alcohol.

Ophthalmological examination.—There was ptosis of the right upper lid and lagophthalmos of the left lower lid. The right eye closed tightly but the left remained open. On an attempt being made at closure, the eyeball turned upwards so that only the sclera showed in the palpebral fissure. There was frequent blinking of the lids of the right eye. The left pupil was larger than the right; both reacted normally to light and to near vision. There was a left internal strabismus of 10 degrees. The right eye moved fully to the right but the movement of the left eye to the right was slightly limited. This movement to the right was accompanied by gross horizontal nystagmus of the right eye, with nystagmus of a much finer excursion in the left eye. There was complete loss of conjugate movement to the left. Upward and downward movements were full. Convergence was full and well maintained. Right vision was 6/18, and with + 0·5 sph. it was 6/12. With the addition of + 2·5 sph. Jaeger 2 was read. Left vision was 6/12, and with + 2·5 sph. Jaeger 1 was read. Tension was normal in both eyes. As the patient complained of troublesome watering of the left eye, lacrimal secretion was certainly not diminished.

Ophthalmoscopic examination.—There were peripheral lens striae in both eyes. The optic discs were rather pale, and the retinal vessels sclerosed.

Visual fields.—The visual fields showed slight concentric contraction for a 5 mm. white disc. There was no central scotoma for colour.

Summary of positive findings

1. Paralysis and wasting of all the muscles of the left side of the face.
2. Left internal strabismus.
3. Loss of conjugate movement of both eyes to the left.
4. Right ptosis.
5. Unequal pupils.
6. Horizontal nystagmus when looking to the right.
7. Slurring speech.
8. Sclerosis of retinal vessels.
9. Unsteadiness of gait with a tendency to fall to the left.

Discussion on positive findings

The facial paralysis.—Since the upper as well as the lower facial muscles on the left side were paralysed and wasted, the lesion must be a lower motor neuron lesion, and may be anywhere between the stylo-mastoid foramen and the facial nucleus in the

pons. Evidence, however, will be given that the 7th nerve was involved where its fibres sweep round the 6th nerve nucleus.

The normal action of the external rectus muscle.—The action of one individual external rectus muscle is to rotate the eyeball externally along its horizontal axis. In no movement of the eyes however is one external rectus muscle individually put into action; it is always associated with some other muscle of the other eye to produce a co-ordinated movement of the two eyes. In lateral movement of the eyes the action of the homo-lateral external rectus muscle is associated with the contra-lateral internal rectus muscle.*

Convergence and divergence.—When the eyes are at rest the visual axes of the two eyes are parallel, or more usually slightly divergent. Before a near object can be fused to form a single image, the visual axes must converge, the amount of convergence depending upon the distance of the object from the eyes, and to a lesser extent upon the pupillary distance. It is now generally accepted that there is a centre for convergence, and that it is situated in the median nucleus of Perlia. When the eyes are in a state of convergence, before the visual axes can again become parallel the eyes must diverge. This can only be brought about by the action of the external recti. There is some divergence of opinion as to the existence of a centre for divergence (Duke-Elder, 1932); those dissenting maintain that the visual axes will attain a parallel position upon relaxation of the internal recti. With this hypothesis I do not agree, since according to the universally accepted theory of reciprocal innervation, upon relaxation of convergence the external recti must be brought into action. Furthermore when conjugate lateral movement and convergence take place as a combined action, before the eyes can again diverge, the eyes meantime remaining in the lateral position, the intervention of a divergence centre would appear to be essential.

Centre for lateral conjugate movement.—There has long been experimental and clinical proof that a centre for lateral movement of the eyes is situated in the second frontal gyrus in the posterior part of the frontal convolution (Russell, 1894). Vascular lesions in this area tend to stimulate the centre, causing the eyes to deviate away from the side of the lesion; this stimulation later gives place to paralysis, which causes loss of lateral movement towards the side opposite to that of the lesion.

Nerve path from cortex to supra-nuclear centre.—The exact route of this pathway has not as yet been accurately traced. Clinical proof, however, has been given by (Holmes, 1921) and

* In this connection it is worthy of note that I have been unable to find in the literature a description of a case that demonstrated a supra-nuclear 6th nerve lesion which caused an isolated paralysis of one external rectus muscle.

(Collier, 1927) that it decussates before reaching the supra-nuclear centre. (Riley, 1930) gives a description of the route, but omits the decussation. His description is as follows: "fibres arising in the cells of Betz pass into the corona radiata and enter the genu of the internal capsule. They then run downwards along with other cortico-bulbar axons which together constitute the aberrant pyramidal tract. The peduncular contingent of the pyramidal tract that is destined for the supply of lateral movement leaves the cortico-nuclear tract as two bundles of fibres, the pes lemniscus superficialis and the pes lemniscus profundus in the mid brain and upper pontine regions, descend for a short distance in the mesial fillet and then proceed dorsally in the tegmentum to the centre for lateral movement which is situated close to the abducent nucleus."

Experimental stimulation of the visual cortex.—If the visual area of the occipital cortex be stimulated with faradic current conjugate deviation of the eyes takes place, the direction of the movement depending upon the area stimulated (Schäfer, 1888).

Reflex of regard.—When an image of an external object is projected on to the periphery of the retina, this reflex so turns the eyes that the image is projected on to the maculae of both eyes. A moving image on the periphery of the retina appears to stimulate the reflex better than a stationary image, so the reflex is really for the preservation of the organism. Moving objects approaching from the side stimulate the periphery of the retina, the impulse is carried to the occipital lobes and passes to the supranuclear centre for lateral movements of the eyes. The eyes are immediately turned so that the image of the approaching object is projected on to the macula, there to be clearly defined as a source of danger or otherwise and avoided or welcomed as the case may be.

The fixation reflex.—When the image reaches the macula, this reflex tends to keep it there, the eyes moving to keep pace with the object in all its excursions.*

Supranuclear centres.—As no single oculo-motor muscle can individually be brought into action, supranuclear centres would appear to be necessary to correlate the action of groups of muscles so as to produce a combined and co-ordinated movement of the two eyes. The co-ordinated movements for which supranuclear centres appear to be necessary are:—

1. Convergence.
2. Divergence.
3. Conjugate lateral movement to the right.

* This reflex not only turns the eyes but also the head. Anyone suffering from a stiff neck is not long left in doubt about the neck muscles being accessory eye muscles.

4. Conjugate lateral movement to the left.
5. Upward movement.
6. Downward movement.

Lesions causing loss of convergence, and paralysis of conjugate lateral, upward, or downward movement as isolated defects are comparatively common. Loss of divergence or more exactly loss of relaxation of convergence is not so common. A case was reported by (Dumphy, 1928), however, in which diplopia was experienced when a distant object was looked at. There was no strabismus, eye movements were full and the diplopia disappeared when a near object was looked at. A patient of my own had the same complaint, but the defect was spasm of convergence and accommodation—a hysterical manifestation cured by luminal, and atropine by mouth, as she would not allow drops to be put into her eyes. The hypothesis that the 6th nucleus was the pacemaker for lateral conjugate movement of the eyes, and that the centre was actually situated in the 6th nerve nucleus held sway for many years (Kidd, 1922). Accumulated experimental, pathological and clinical evidence makes this hypothesis untenable and it is now generally believed that a supra-nuclear centre exists close to but distinct from the 6th nerve nucleus. The accumulated evidence that there is a supra-nuclear centre and that the connecting fibres run in the posterior longitudinal fasciculus is as follows.

1. In no experimental or pathological lesion of a 3rd nerve has chromatolysis been found in the opposite 6th nucleus. This proves that fibres from the 6th nucleus do not enter the contralateral 3rd nerve (Kidd, 1922).

2. Injuries of the internal capsule or peduncle do not cause degeneration of fibres in the posterior longitudinal fasciculus; there must therefore be a relay station before the fibres reach the posterior longitudinal fasciculus (Spiegel, 1933).

3. In all cases of paralysis of conjugate movement examined histologically, degeneration of the fibres of the posterior longitudinal fasciculus has been found (Kidd, 1922).

4. Certain instances of loss of movement of the homolateral eye outwards with retention of the conjugate movement of the contralateral eye inwards have been described in which the 6th nucleus was completely destroyed, thus showing that the centre for lateral conjugate movement cannot be situated in the nucleus itself, although other pathological evidence would indicate that the centre was situated close to the nucleus (Riley, 1930).

Many experiments have been performed on animals in an endeavour to place the centre accurately. Different areas of the pons have been stimulated and erroneous conclusions have been drawn from the resulting eye movements. Duval and Laborde

(1880) thought they obtained conjugate movement of the eyes by stimulating the 6th nucleus but the movement was probably brought about by stimulating the adjacent posterior longitudinal fasciculus or vestibulo-ocular pathway. (Spiegel, 1933) stimulated the posterior longitudinal fasciculus and obtained conjugate lateral movement. As he stated that cortical fibres descend in the posterior longitudinal fasciculus he had no reason for his assumption that he was stimulating fibres that proceeded to the homolateral 6th and contralateral 3rd nuclei.

If we assume that there is a supra-nuclear centre for lateral conjugate movement, and that the connecting fibres run in the posterior longitudinal fasciculus, then we should be able to differentiate clinically between lesions situated in the following situations.

1. Infranuclear.
2. Nuclear.
3. Internuclear.
4. Supranuclear. { cortical. / occipital. / vestibular.

(1) *Infranuclear.*—A lesion of the 6th nerve peripheral to the nucleus causes a paralysis of the external rectus muscle of the same side. The lesion is of the lower motor neuron causing a flaccid paralysis of the muscle supplied. The eye deviates inwards about 10°; there is complete loss of outward movement on the side of the paralysis with full movement inwards of the opposite eye.

(2) *Nuclear.*—A lesion of the 6th nerve nucleus also causes a lower motor neurone lesion indistinguishable from a lesion of the peripheral nerve. As an isolated sign, it would be clinically impossible of diagnosis. Fortunately a lesion limited to complete destruction of the cells of one 6th nerve nucleus is extremely rare (Siemerling and Boedeker, 1897) and can be due only to a primary degeneration of the nerve cells. If due to a vascular lesion or tumour, surrounding structures are involved which give rise to a combination of signs which localize the lesion with extreme accuracy. Such a combination of signs in this instance is known as Foville's syndrome, which consists of paralysis of conjugate lateral movement towards the side of the lesion associated with a peripheral paralysis of the 7th nerve on the same side. Besides destruction of the 6th nucleus there is possibly destruction of the supra-nuclear centre or destruction of the posterior longitudinal fasciculus. Haemorrhage would cause a much more widespread lesion than would be caused by thrombosis or embolism blocking a single median branch of the basilar artery; the former condition would therefore involve other tracts which would give additional signs.

(3) *Internuclear.*—An inter-nuclear lesion would be situated in the posterior longitudinal fasciculus and would give rise to the following signs.

(*a*) Paralysis of inward movement of the contralateral eye upon lateral conjugate movement, with retention of full inward movement on convergence and with full outward movement of the homolateral eye (Holmes, 1921).

(*b*) Nystagmus.

(4) *Supranuclear.*—If the lesion involves the centre, then all reflex and voluntary lateral movement towards the side of the lesion is abolished. If above the supra-nuclear centre there are three possibilities.

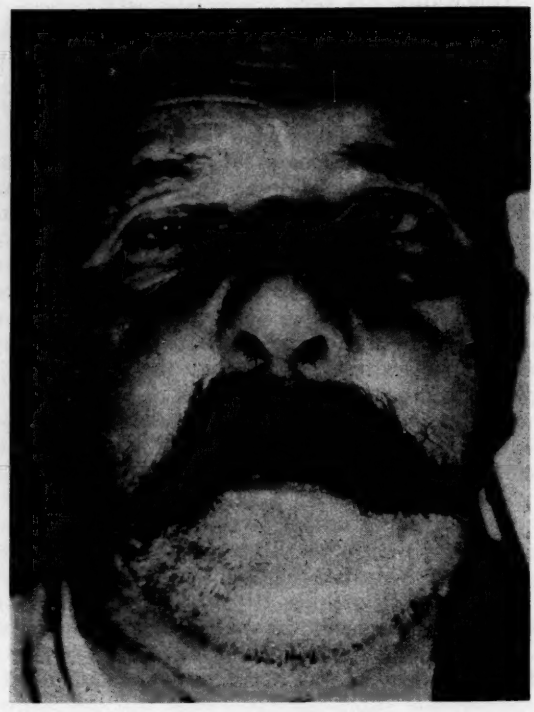

FIG. 1.

Front view of F. D. showing flaccid paralysis of all the muscles of expression of the left side of the face.

FIG. 2 (*a*).

The eyes in ordinary light. There is right ptosis and a left lagophthalmos; the left pupil is larger than the right; there is a left internal strabismus of 10 degrees.

FIG. 2 (*b*).

The eyes in darkness, photograph taken by flash-light. The pupils are half dilated, the left still being the larger.

Fig. 2 (*c*).

Attempt made to turn the eyes to the right. There is a full movement of the right eye to the right, but the movement of the left eye to the right is slightly limited.

FIG. 2 (*d*).

Attempt made to turn the eyes to the left. If the corneal reflections are compared with 2 (*a*) it will be seen that there is complete loss of movement of both eyes to the left.

FIG. 2 (*e*).

Upward movement of both eyes is full.

(*a*) *Cortical.*—A lesion of the frontal lobe causing destruction of the centre for voluntary lateral movement or a lesion in the descending tract to the mid brain, would cause loss of voluntary movement away from the side of the lesion if the lesion is above the decussation of the fibres, and towards the side of the lesion if below the decussation. There is no diplopia as reflex control from the occipital lobes, cerebellum and vestibular system is retained. The normal tonus supplied by the 6th nucleus to the external rectus muscle is also retained.

(*b*) *Occipital.*—With a lesion of the pathway from the superior colliculus to the supra-nuclear centre a patient would be unable to follow an object with the eyes when it is moved laterally away from the side of the lesion.

If a patient has a lesion involving an occipital lobe that is producing a hemianopia, the reflex of regard must of necessity be abolished as all objects to the hemianopic side are not seen. As the fixation reflex in my opinion is entirely macular in origin a lesion of one occipital lobe should not interfere with it.

(*c*) *Vestibular.*—A lesion of the vestibular nucleus or vestibulo-ocular tract would give rise to nystagmus and loss of the head turning reflex, accompanied by unsteadiness of gait with a tendency to fall to the side of the lesion (Oppenheim, 1911).

To make a complete examination of conjugate lateral movements of the eyes the following three tests are necessary:—

1. The patient is asked to look to the right and to the left, the head meantime being kept stationary.
2. The eyes are made to follow the excursions of an object moved laterally, first to one side and then to the other.
3. The patient is asked to fix an object in front of the eyes, the head being meantime turned passively to the right and to the left.

Description of the pons at the level of the 6th nerve nucleus.—The relative anatomy can most easily be described by means of a cross section of the pons at the level of the 6th nerve nucleus (*Fig. 3*).

It will be seen that the 6th nucleus lies in the floor of the 4th ventricle near the mid line and beneath the colliculus facialis.

The fibres from the nucleus pass forwards and downwards without decussating through the whole thickness of the pons, passing medial to the superior olivary nucleus and lateral to the pyramidal tract, and emerge as several rootlets in the groove between the pons and the medulla, lateral to the prominence of the pyramid.

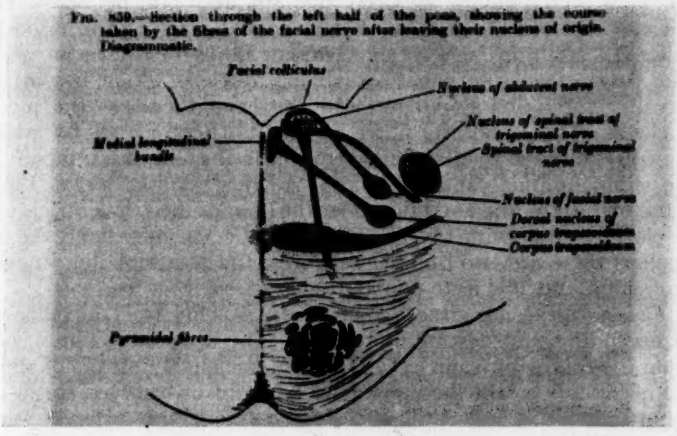

FIG. 3.

From Gray's text-book of Anatomy, 26th Edition. (With kind permission of the publishers.)

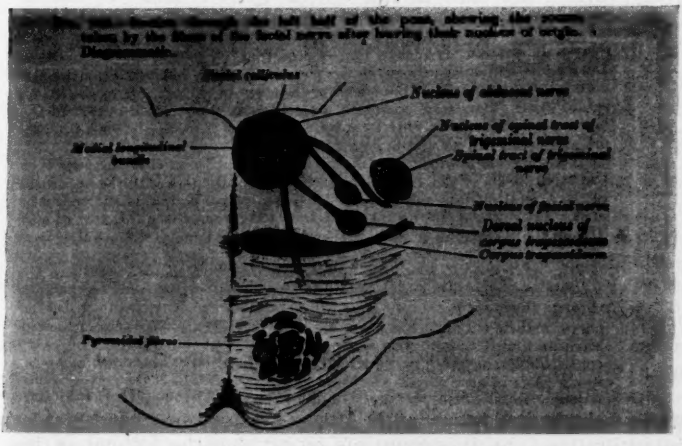

FIG. 4.

Showing the probable situation of the lesion.

The 7th nerve nucleus.—The nucleus of the 7th nerve is situated in the ventral portion of the tegmentum medial to the descending root of the 5th nerve and lateral to the superior olive. The fibres of the 7th nerve leave the nucleus and run towards the floor of the 4th ventricle, encircling the 6th nerve nucleus like a horse-shoe. They then traverse the tegmentum and transverse fibres of the pons and emerge between the 8th and 6th nerves. The nucleus receives fibres from the pyramidal tract of the opposite side. In addition some of the efferent fibres of the facial nerve take origin from the superior salivary nucleus which lies in the reticular formation dorsilateral to the caudal end of the motor nucleus. This sends its fibres to join the motor root by which they are ultimately distributed through the chorda tympani to the submandibular and sublingual salivary glands (Gray, 1935). Close to the mid line and lying near the floor of the 4th ventricle and in close relation with the root fibres of the 7th nerve and the 6th nucleus there are two bundles of fibres, the posterior longitudinal fasciculus and the tecto-spinal tract.

The posterior longitudinal fasciculus.—This tract is made up of ascending and descending fibres. The ascending fibres come from the following sources (*a*) Deiter's nucleus by means of which connection is established with the 6th and 3rd nerves, bringing them under the direct influence of the cerebellum and vestibular systems.

(*b*) Fibres from the sensory nucleus of the 5th nerve correlating the movements of the eyes with sensory impressions received from the head, especially from the conjunctivae.

(*c*) Fibres from cells in the ventral gray column of the spinal cord.

(*d*) Fibres from the 6th and 4th cranial nerve nuclei. The descending fibres are largely derived from the nucleus interstitialis of Cajal.

The tecto-spinal tract.—This tract rises in the superior colliculi and passes by way of the arciform fibres to the dorsal tegmental decussation of Meynert. From this point it forms a compact bundle which descends in relation with the posterior longitudinal fasciculus through the pons and medulla into the ventral white column of the spinal cord. It serves to activate reflex movements in the facial musculature, in the arms, trunk and neck in response to visual impressions.

Blood supply to the pons

For long the minute anatomy of the blood supply to the pons was not known. Stopford in 1915, however, made an exhaustive investigation, and it is from his report that the following description is mainly extracted.

Normally the pons receives its blood supply from the basilar artery and its branches. The basilar artery originates at the lower border of the pons by the fusion of the two vertebral arteries and terminates at the upper border of the pons by dividing into the two posterior cerebral arteries. It lies on the ventral aspect of the pons in the median groove formed by the pyramidal fibres. It is separated from the basisphenoid by the arachnoid and dura mater only.

Pontine branches.—A. Minute branches which arise from the surface of the basilar artery lying in contact with the pons which at once enter the substance of the brain along the median groove. B. A set of transverse rami which extend laterally and subdivide as they proceed into smaller branches which penetrate the ventral surface of the pons at right angles to the parent vessel. These vessels are generally arranged symmetrically on the two sides, but are variable in size and number.

The anterior inferior cerebellar artery.—This artery passes laterally and somewhat caudally from its origin over the ventral surface of the pons towards the cerebellar hemisphere of its own side, on to the anterior part of the inferior surface of which it extends to anastomose with the posterior inferior cerebellar artery.

The median pontine branches are all end arteries but (Stopford, 1915) thought that the terminal ramifications spread out and ran cephalwards for a short distance in the grey matter in the floor of the 4th ventricle. The median pontine branches supply the structures immediately lateral to the middle line in the tegmental part. This includes the nuclei of the 6th, 4th and 3rd nerves, the fibres of the 7th nerve; the median longitudinal bundle, the medial lemniscus, and the tecto-spinal and thalamo-olivary tract; transverse pontine fibres and the medial part of the corpus trapezoidum. The transverse fibres supply the brachium pontis, lateral part of the corpus trapezoidum, superior olive and the nuclei of the 5th, 7th and 8th nerves. According to (Stopford, 1915) the basilar was found to follow a more constant course than any of the cerebral arteries he studied, but it manifested arterial disease much more frequently than the others. He points out that embolism of the basilar artery is rare because fragments which have passed uninterruptedly through the vertebral would scarcely be likely to become lodged in the former artery which is larger than the latter. If obstruction occurs it is seen only at the bifurcation to form the two posterior cerebral arteries. Occlusion from embolism or thrombosis inevitably results in death as degeneration ensues of all the descending fibres of both sides including those which pass to the vital centres of the bulb and caudal part of the pons. In conducting this investigation on the cadaver

Stopford ligatured the basilar artery just before it divided into its terminal branches and also the lateral branches. He then injected a dye into the caudal end of the artery. Sections of the pons were then made, the stained area representing the distribution of the median branches. No attempt was made to inject individual median branches so it is not known whether or not the 6th nerve nucleus is supplied by a separate and distinct branch. Bernheimer (1899), however, traced a separate artery to the Edinger-Westphal nucleus, so possibly the 6th nucleus and its vicinity is supplied by a separate artery.

Diagnosis

From the evidence supplied and taking into account the sudden onset, the non-progressive nature of the lesion, the state of the retinal arteries and the fact that the lesion is confined to such a small area of the pons my diagnosis is thrombosis of a median branch of the basilar artery.

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A PROJECTION SCOTOMETER

BY

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THE mapping out of visual fields by the usual method is handicapped (*a*) by the sound (*b*) by the sight of the carrier of the test object. Both of these objections are surmounted by the use of a spot of light projected on to the screen, and various methods have been used from time to time by which this desideratum can be provided.

The principle is used in the Maggiore perimeter made by Zeiss, but the cost of this instrument is too high for most individuals. A similar device, not self-registering, was brought out by John M. Evans for use with a Ferree Rand perimeter, but on the whole the present perimeters in common use are efficient for most clinical purposes.

In examining the central field, however, the method in common use with the Bjerrum screen in this country is to use Traquair's discs of varying sizes. To the discs themselves little exception can be taken save that the smallest (1 mm.) sizes are apt to be inaccurate in diameter and to be dingy in shade; but the chief objection is the long holder of the discs which, even in its new state, is apt to reflect light from its painted surface, and when worn from use has a definite metallic shine. This may interfere with the accuracy of the record.

From time to time instruments have been made which have been designed for projection scotometry; I found one first at the Central London Ophthalmic Hospital which had been designed by the late Stephen Mayou, possibly six or more years ago; this was manufactured by Messrs. Keeler and formed the basis for the model which is described below, but I can find no record that Mayou published any note of his device.

In 1932 Bishop Harman demonstrated a projection model at the meeting of the British Medical Association. This consisted of two tubes containing filament lamps both of which projected patches of light on to a screen. One of these patches acted as the fixation spot. The other could be varied in size by a series of diaphragms and in colour by filters. Recording was carried out by a prism device, whereby a small beam was diverted from one of the main beams and directed on to a chart. By pencil marks on this chart the field or scotoma was mapped out. I have no personal acquaintance with this apparatus.

The New Model

The apparatus now to be described aims at the same result as the Bishop Harman instrument, the test object being a spot of light on a grey surface; the advantage claimed is that it is a less complicated instrument.

It consists of a single tube containing the lamp and arrangement of lenses together with diaphragms that permit of the projection of a circular uniform light area of diameter varying from 1 to 5 mm. on a screen at one metre distance. With these five sizes of test object, a great variation in the stimulus can be obtained, for in addition to the alteration in size the intensity may be varied (*a*) by altering the resistance of the rheostat and so the illumination of the spot, (*b*) by altering the general illumination on the screen.

By colour filters red and green images are also provided.

The whole is mounted on a substantial stand, and the lamp tube is free to rotate over an angle of some 60 degrees.

The Screen.—Various screens have been tried. Black is useless for it absorbs the light; white gives rather too bright an illumination; a medium grey is found to be the best. The surface must be matt, or reflexes from the illumination of the room cause error; a smooth grey felt or cloth has given satisfaction. For fixation a circular porcelain white button of 7 mm. diameter is effective.

It is well to have the screen mapped out by silk surface threads giving the tangent angle values at the usual working distance. This is useful (*a*) as a check on the automatic registration, (*b*) when the automatic registration is not used. In the latter case the readings are transferred directly by hand to the corresponding map on the field chart.

Automatic Registration.—This is obtained by a pricker on to a chart at the back of the instrument, and is satisfactory.

The instrument can also be supplied in a simpler form without automatic registration, either on a stand or as a simple tube held in the practitioner's hand. The latter has some advantage in that it can also be used as a projector on any simple perimeter which has a grey surfaced arc.

General Illumination.—The examination is best conducted in the dark room with medium illumination on the screen. Care must be taken that the illumination on the screen is uniform and that there is no marked reflection from its surface. It is found that with the grey matt surface two lateral flood lighting lamps with opal glass fronts give satisfactory diffusion.

Method of Use.—The patient is seated comfortably in a chair, his eyes being one metre distant from the screen and slightly to one side of the fixation zero mark. One eye is of course covered.

The instrument is then adjusted, so that the objective lens at the end of the tube is one metre from the screen, close beside the patient's head. The central registration pin being in the zero position, the projection lamp is switched on and the position of the instrument is adjusted so that the registration zero corresponds with the fixation point. The central pin is then withdrawn and the pricker registration is ready for use.

The image on the screen is focused to a sharp edge and the disc aperture required is turned into position.

In the usual routine I commence by demonstrating the blind spot with a light disc of 2 or 3 mm. diameter, and then search for general depression of the central field or for arcuate scotomata

The photograph shows the general appearance and method of use of the projection scotometer (one eye of the subject should have been covered).

with the same object. The smallest test object can then be used. In tobacco cases the demonstration of caeco-central scotomata for red and green is easy, and, if necessary, the intensity of the colour can be increased greatly by dimming the general illumination falling on the screen.

The criticism may be made that a chin rest is essential for accurate work, but personally I find that this is not necessary, for it is the visual fixation of the zero which is least steady. With the patient in a comfortable chair there is no antero-posterior movement of the head, whilst slight lateral movements do not matter.

The apparatus can of course be used at two metres distance, and has been tested out at this distance by Messrs. Cross and Ayoub, resident medical officers at Moorfields. They report that at that distance the plotting out of the retinal vessels (angioscotometry) is possible; this is good proof of the delicacy of the apparatus.

Experience in Clinical Work

I have now used this apparatus for over a year and can report that it is a definite advance on the ordinary method with screen and discs on holders. Patients find it easy, and those who have been tested by other methods are unanimous with regard to the facility with which they can give accurate replies.

It has been suggested that for scientific work one should be able to give the variants used in the apparatus, for example the intensity of light in the test spot, the intensity of light falling on the general surface of the screen, the absorption value of the greyness of the screen, and so on. It has been found impossible to do this satisfactorily. The intensities in candle power are so low, and the absorption value of the cloth is so difficult to obtain, that such data would be of no clinical value. Again, the life of the lamp in the tube, and the cleanliness of the cloth, are variables which would vitiate the delicate figures of the other data to an amount which would not make them worth while.

For practical purposes, one requires first of all such combination of size and intensity of test object and illumination of screen which to the normal eye gives a visual field of 10° to 15° only. That is easily arranged when the apparatus is in place by adjusting the rheostat and the general screen illumination whilst testing several normal individuals with the smallest aperture. This then is the minimal stimulus required, and the larger apertures will suffice for the stronger stimuli.

Mr. Charles Keeler is responsible for the design and manufacture of the instrument.

THE THEORIES ON THE FORMATION OF THE AQUEOUS HUMOUR*

BY

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FOR many years there has been controversy, becoming very bitter at times, regarding the mechanism of formation of the aqueous humour. This fluid has at various times been considered a dialysate, a transudate, an exudate or a secretion, and very strong arguments have been brought forward for and against the various concepts by particular experimentalists partial to one or the other theory.

Before going on to a study of the various theories in relation to the eye, it is important to define what is meant by the terms dialysate and ultrafiltrate, exudate, transudate, and secretion. As an introduction to their definitions I would like to refer very briefly to crystalloids and colloids, and to the permeability of membranes.

Crystalloids and Colloids.—The division of substances into the two large groups of crystalloids and colloids is due to the work of Graham (1876) the pioneer in colloidal research. Crystalloids, he maintained, examples of which are sodium chloride, sugar and magnesium sulphate, *are fast diffusers*, whereas colloids, examples of which are albumen, caramel, silicic acid, gum-arabic and tannin, are *slow diffusers*. As a general rule when solutions of colloids are evaporated to dryness they leave a gluey or glassy residue in contrast to crystalloids that crystallise out in saturated solutions. There are, however, certain colloids capable of crystallisation such as vegetable proteins, haemoglobin, and egg and serum albumen, so that crystalloids in contrast to colloids might be simply defined as substances with a high rate of diffusion and crystallising out easily in saturated solution.

The permeability of membranes.—A membrane may be completely impermeable. This is very rare but it occurs in the case of the membrane surrounding an egg. Most membranes are permeable to a small or large degree, depending on the fineness of the grain—*i.e.*, the size of the holes through which the fluid passes. Filter paper permits the passage of water and all dissolved substances crystalloid or colloid. Gel membranes such as gelatin collodion or cellophane are of porous structure and they

*Lecture delivered at the Royal London Ophthalmic Hospital on November 25, 1938.

have varying degrees of permeability. Some gel membranes are of coarse texture and they allow the passage of colloids as well as crystalloids, on the other hand some like cellophane keep back all the colloids and only allow the passage of water and crystalloids.

In general terms it may be said that the ability to pass through a membrane depends on the size of the particle in solution, and a semi-permeable membrane, for example cellophane, acts like a filter paper made infinitely fine.

Dialysates and ultrafiltrates.—Ultrafiltration may be defined as: "*the process of separating substances in solution from one another.*" Dialysis is therefore a special type of ultrafiltration the process *of which consists in separating crystalloids from colloids.* The process of dialysis can be explained by taking a very simple example where this occurs. If we put some fluid containing a mixture of colloids and crystalloids (*e.g.*, blood plasma) in a bag of cellophane and hang it up in a large tank of distilled water, the crystalloids such as urea, sugar, etc., will diffuse out through the cellophane membrane into the tank. If the water in the tank is changed frequently, then eventually we obtain a fluid inside the cellophane membrane quite free from salts and crystalloids but containing the whole of the colloids originally present. The serum will of course be diluted with water because the colloids retained inside the cellophane possess the property of attracting fluid. This process of freeing a colloidal solution from crystalloids is known as dialysis.

Osmotic Pressure.—The property which indiffusible colloids have in attracting fluid through a membrane is known as their osmotic pressure. The osmotic pressure of colloid varies according to the amount of colloid present.

Thus 1 gram per 100 c.c. of albumen attracts 7·54 cm. water. 10 gram per 100 c.c. of albumen would attract 75·4 cm. water. 100 c.c. blood plasma which is a mixture of albumen and globulin attracts 40 cm. water.

Production of a pure ultrafiltrate of blood plasma.—If instead of placing the cellophane bag containing blood plasma in a tank of water, a certain pressure is put on the contents of the cellophane bag then fluid will pass out of the bag by so-called ultrafiltration. If the pressure is over 40 cm. water (or greater than the osmotic pressure of the colloids in the serum) then a filtrate will be produced through the cellophane membrane. This we call an ultrafiltrate or a dialysate of blood.

So when we speak of a biological fluid as being a dialysate or ultrafiltrate of blood it means the production or formation of that fluid is similar to that which has just been described. Instead of the cellophane membrane we have the simple endothelial layers

found in the blood and lymph capillaries, glomerulus of the kidney or on serous surfaces. From our knowledge of physical chemistry we know that water and non-colloidal solutes will endeavour to flow across the capillary membrane always to the side which contains protein or colloids in greater concentration. Some force is required to balance the osmotic pressure of the colloids in such systems. This force is found in the hydrostatic pressure. In certain parts of the capillary the hydrostatic or blood pressure in the capillary exceeds the colloid osmotic pressure by an amount sufficient to produce an ultrafiltration and so we have the formation of an ultrafiltrate of blood produced exactly as we would manufacture it experimentally.

What are the characteristics of dialysates or ultrafiltrates? They may be divided into physical and chemical.

Physical.—The physical equilibrium is such that the formation of dialysates in the body is governed by simple physical laws reproducible *in vitro*. The hydrostatic or intracapillary blood pressure wants to drive filterable fluid through the membrane, whereas the indiffusible colloids want to attract fluid inside the capillary. The circulation of fluid to and fro over the capillary membrane, which we know to exist, is explained in two ways.

a. At the arterial end of the capillary the hydrostatic pressure is greater than colloid osmotic pressure, whereas at the venous end of the capillary, the hydrostatic pressure is less than the colloid osmotic pressure. By this arrangement, tissue fluid is produced at the arterial end and absorbed at the venous end. It thus allows of a circulation of fluid through the tissues.

b. Against this simple mechanism it has been suggested that the capillaries throughout their entire length are either producing filtrate or absorbing fluid, so the hydrostatic capillary pressure at one time exceeds the colloid osmotic pressure and at another time is less than it.

The pressure of the filtrate or the tissue fluid pressure must obviously depend upon the hydrostatic pressure and the colloid osmotic pressure and the relationship is as follows. The dialysate pressure = the hydrostatic pressure in the capillaries, *minus the difference in osmotic pressure* between blood and the dialysate.

Now the difference in osmotic pressure between blood and its dialysates is simply the difference in osmotic pressure of the fraction of indiffusible protein because there is complete equilibrium otherwise. So we may rewrite this equation : the dialysate pressure = hydrostatic pressure – difference in colloid osmotic pressure of blood and the dialysate. Thus if the dialysate contains no protein at all, the dialysate pressure = hydrostatic pressure minus the colloid osmotic pressure of the plasma.

The Chemical Equilibrium.—The question of the chemical

equilibrium was fully discussed in my second lecture, but to summarise the various points:—

1. Protein may be present in varying amounts depending on the permeability of the capillary membrane.

2. Freely diffusible non-electrolytes such as non-protein nitrogen, urea, creatinine, uric acid, and sugar are present, in equal concentrations in blood plasma and its dialysates.

3. Cations such as sodium, potassium, magnesium, and calcium are present in greater concentration in the blood plasma than in the dialysate.

4. Anions such as chloride and phosphate, are present in less concentration in the blood than in the dialysate.

5. The product of any pair of diffusible cations and anions in the blood is equal to the product of the same pair of cations and anions on the other side.

Thus—

[Na] blood × [Cl] blood = [Na] dialysate × [Cl] dialysate

where the concentrations of Na and Cl are expressed in grams molecules per litre of solutions.

Regarding dialysates of blood therefore, there is definite physico-chemical equilibrium, and for a fluid to be termed a dialysate it must conform to this equilibrium.

Exudate and transudate.—These filtrates of blood can be conveniently studied together. In dialysis the formation of fluid is governed by a simple physical process associated with an exchange of fluid over a membrane. It is possible that the permeability of this membrane may be altered by influences such as anoxaemia, bacterial or chemical toxins, so that the normal interchange of fluid becomes modified in the direction of increased accumulation of fluid. We meet with this clinically in oedema and in accumulation of fluid in the pleura, pericardium, and peritoneum. *If the process is non-inflammatory* in origin the product is called a *transudate.* If the process *is inflammatory* in origin the product is called an exudate.

It is often very difficult indeed to differentiate one from the other, but the following means have been adopted with a certain measure of success.

1. The specific gravity of transudates is below 1,015 and of exudates above 1,018.

2. Exudates contain over 3 per cent. of protein, and transudates under 3 per cent.

3. Transudates are sterile, exudates may contain specific organisms.

4. Exudates contain polymorphonuclear cells in acute infections, and lymphocytes in chronic infections, whereas transudates contain few, if any cells.

The physical and the chemical equilibria of transudates and exudates do not differ from those of dialysates.

Secretion.—One may define secretion in several ways and the following have been suggested.

1. Secretion is the elaboration of a product which contains some substance not present in the mother liquor, or present in marked excess in comparison with the mother liquor.

2. Secretion is the elaboration of a product whose formation is the result of work done by the tissues.

There is no doubt that secretions in the body are derived from the plasma by some complex mechanism ill-understood. The control of secretion has variously been ascribed to a nervous, hormonal, and/or electrolytic mechanism.

Now let us apply these various definitions to the fluid produced in the eye.

Is the aqueous humour a dialysate?—If the aqueous humour is a dialysate, then—

1. The dialysing membrane must be the capillary wall, and thus fluid interchange must occur in both directions over the capillary membrane throughout the eye as a whole.

2. The aqueous must resemble tissue fluid produced elsewhere in the body.

3. The physical equilibrium is such that the intra-ocular pressure must equal the hydrostatic pressure in the capillaries minus the difference in the osmotic pressure of the blood and aqueous humour. In other words it means that the intra-ocular pressure should vary with alterations in the osmotic pressure of blood in the same way as tissue fluid pressure does.

4. The chemical equilibrium should be similar to that of an ultrafiltrate of blood *in vitro*.

Let us deal with these various points.

1. *The dialysate membrane.*—It has been shown that the blood-aqueous barrier in the posterior chamber allows the free passage of water and dissolved substances from the blood to the aqueous. But when the permeability of the ciliary epithelium was tried in the opposite direction, a different result was obtained. Neither water nor dissolved substances was found to permeate the membrane passing in the direction from aqueous to blood. This is an important finding for it means the membrane in the posterior chamber of the eye has an irreversible permeability and therefore the passage of fluid across its walls must be accomplished at the expense of work done by the tissues. It is therefore incorrect to assume, as upholders of dialysis do, that fluid interchange occurs in both directions throughout the eye as a whole.

2. The physical equilibrium in the eye cannot be explained on the simple laws governing dialysis.

a. When the colloid osmotic pressure of the plasma falls below 15 mm. Hg and nephrotic oedema or increased formation of the tissue fluid occurs, no change takes place in the level of the intra-ocular pressure.

b. Dehydration of the tissues with 50 per cent. glucose does not affect the intra-ocular pressure.

c. Dehydration of the tissues with 30 per cent. NaCl is at its maximum at the end of the injection and ¾ hour later the fluid content of the tissues is normal.

One hour after the injection of NaCl, when the water content of the tissues is normal, the intra-ocular pressure is at a minimum.

3. The chemical composition of the aqueous humour is not comparable to that of an ultrafiltrate of plasma.

a. Freely diffusible and easily filterable substances such as urea, uric acid, glucose, and creatinine, do not readily diffuse into the aqueous humour. These substances actually pass over the secreting membrane of the stomach more easily—Robertson and Williams (1939).

b. With the exception of Na and Cl in the opinion of most workers the distributions of ions in the aqueous humour is not in accord with that one would expect from dialysis—Robertson (1939).

4. The aqueous humour therefore, does not resemble lymph which is an example of a fluid produced by dialysis.

Our conclusions are therefore, that the aqueous humour does not fulfil the necessary conditions for it to be considered an ultrafiltrate or dialysate of blood.

Is the aqueous humour a transudate?—I do not think, on the evidence we have, that the aqueous can be called a transudate. It is not an exudate for there is no process of inflammation, which according to the definition of the word, is necessary.

The physical and chemical equilibrium of transudates does not appear to differ in any way from that of dialysates. I cannot understand, therefore, an objection that has been raised against the transudation theory by supporters of the dialysis theory—namely, that the aqueous humour has more chlorides than the plasma. So far as I know all transudates have chlorides in excess of the blood plasma. Further, it has been stated in criticism of the transudation theory—" If the aqueous humour is formed by a pressure transudation and circulates actively through the eye and if it is not a product of thermo-dynamical equilibrium, then the one fact that it contains more chloride ions than plasma forces one to postulate that it is formed by a gland secreting saline." This of course, is not so, for an excess of chloride does not necessarily mean an excess of Na. I do not believe the aqueous humour is a transudate for the same reasons that I do not think it is a dialysate.

The importance of Leber's teaching was that it focused attention on the formation of the aqueous humour in the ciliary processes, that it circulated to the anterior chamber, and gained an exit at the canal of Schlemm. The nature of this fluid had to wait until more accurate methods of chemical analyses were available.

Is the aqueous humour a secretion?—In answering this question, Friedenwald and Pierce (1931) have said it all depends on the definition of the word secretion. They have written—"If one defines a secretion as a cellular product which contains some substance not present in the mother liquid or present in marked excess in comparison with the mother liquid, then the aqueous is not a secretion. If, on the other hand, one defines secretion as a substance whose formation is the result of work done by the tissues then the aqueous is a secretion."

I think I would go a little further than Friedenwald and Pierce. On the following grounds I believe the aqueous humour is produced by a process of secretion.

1. There is evidence that work is done or energy is expended in its formation. This must be so or the membrane in the posterior chamber of the eye would not have an irreversible permeability.

2. With regard to its specific secretion, it does not necessarily follow that because a specific substance has not yet been identified it is not present in the aqueous humour and manufactured in some site in the eye. Meyer and Palmer (1936) in fact believe that they have isolated a polysaccharide acid called hyaluronic acid in the aqueous humour, and no such material has been found in the blood. It will be interesting to note if Meyer and Palmer's work is confirmed.

3. In my investigations I have noted a certain similarity between the eye and a secretory mechanism, namely the stomach—

i. The blood-aqueous barrier and the blood-gastric juice membrane appear to hold back to the same extent freely diffusible substances such as urea, sugar, and creatinine.

ii. 50 per cent. glucose injected intravenously does not inhibit gastric secretion, nor does it materially affect the intra-ocular pressure. When I compare the volume of gastric juice secreted with the intra-ocular pressure I am assuming for reasons I have given in my second lecture that a fall in the intra-ocular pressure indicates an inhibition in the formation of the aqueous humour.

iii. 30 per cent. NaCl inhibits the secretion of gastric juice and also the formation of the aqueous humour. In both the stomach and the eye this inhibition of fluid formation may last several hours after the injection, *not, as in the case of dialysates only over the period the injection is being given.*

The evidence upon which I believe that the aqueous humour

is produced by secretion is therefore based more on physiological facts than upon data such as:—

1. Anatomy of the ciliary processes.
2. Cytological evidence of functional activity.
3. Electrical evidence.
4. The stimulation of secretion by drugs or by nerves; and in the opinion of many workers these last four methods of investigation in themselves produce very strong evidence as to the secretory nature of the intra-ocular fluid.

In conclusion I would like to thank the Honorary Staff of Moorfields Royal Ophthalmic Hospital for the honour they have done me in inviting me to give these lectures.

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A DESCRIPTION OF A MONSTER, DIPROSOPUS TETROPHTHALMUS

With notes on the histology of the median eyes by John Maude

BY

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AN uncommon monstrosity which is an example of superior duplication, was recently presented to the Department of Pathology, University of Sydney, by the Royal Alexandra Hospital for Children.

The specimen may be designated diprosopus tetrophthalmus in association with anencephaly.

In the following notes the external features will be described and illustrated; a short description of the internal anatomy, the microscopical appearances of the median eyes, and the radiographical features (together with reproductions of the radiographs) are also incorporated.

External description.—The foetus is a white female. It weighs 2,668 grammes (5 pounds, 14 ounces) and the length from the most superior point to the heel is 42 centimetres (16½ inches).

* Working under a grant from the National Health and Medical Research Council, 1938.

The vault of the skull is absent. In the midline of the floor of the skull there is a bony projection which may be the fused posterior clinoid processes, and anterior to it is a small piece of nervous tissue corresponding in site and shape with a pituitary body. The surrounding tissue, of which there is very little, is dark brown, soft and friable. Peripherally an irregular line marks the junction of the meninges with the skin. A remnant of the upper end of a single spinal cord is evident.

The facial area is broad. On each side is an ear, both being folded to such a degree that the external auditory meatus is not visible. On the left side the supero-posterior margin of the helix hangs over the lower edge of the pinna. The helical margin is thinner at the point where the folding is most acute.

Three bulgings above the bilateral noses contain eyes. The eyes and palpebral margins of the lateral eyes appear normal,

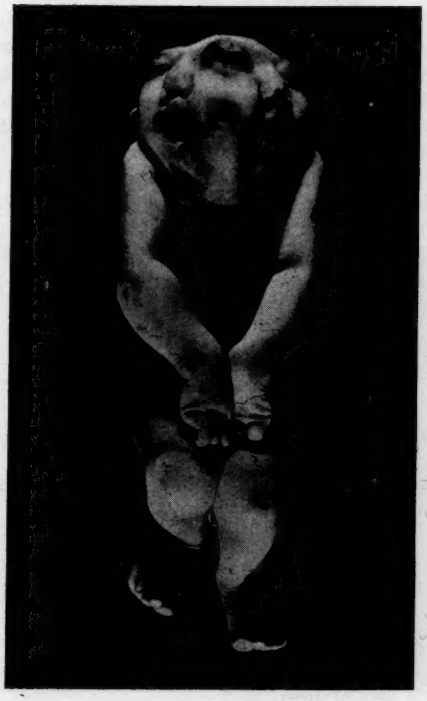

FIG. 1.

The anterior view of the monster.

notwithstanding an epicanthal fold at the inner angle. A description of the central bulging is deferred. In the midline, almost directly below the concavity in the lower eyelid of the central bulging, and slightly above the level of the corners of the mouths, there is a pit 1·5 mm. in diameter. Its depth is 8 mm.

Two noses are symmetrically placed, but the one on the right side is flattened at the tip (probably due to faulty mounting). Each lateral nostril has a posterior defect lined by mucous membrane, which has been prolonged into it from lateral hare lips, which preserve the general symmetry. The anterior portions of the palate of both mouths show a lack of apposition between the maxillary and globular elements on the outer side, and correspond with the hare lips. In the floor of each mouth is a normally formed tongue. Two chins are present, between them lying a common central cheek. The neck is poorly represented. It is delineated laterally by a deep groove between the shoulder and the lateral cheeks, the grooves being continued medially in the form of a faint crescentic line.

The limbs and the body appear to be normal, though the upper limbs have assumed a grotesque attitude in the mounting.

The anus and vagina are patent.

Internal description.—The buccal cavities do not communicate with each other except at the posterior end, where they open into a common pharynx. From the posterior pharyngeal wall an irregular pyriform lump, 1·5 centimetres long, projects upward and forward. The lump is attached by a stalk and a broad attachment to the left lateral wall. A section of the lump demonstrates cartilage, mucous glands, striped muscle; and a layer of high columnar epithelium on one side.

There is only one oesophagus. Ventral to it is a single trachea with lobes of thyroid gland, unconnected by an isthmus, applied to its lateral aspects. Two separate masses of thymus gland face ventro-laterally, but no designation other than descriptive can be given to two flat elongated plaques of tissue which lie medial to the lobes of the thyroid.

The right lung has an irregular arrangement of its lobes, the intermediate lobe being four times larger than the combined aggregate of the apical and basal lobes.

The heart is small and measures approximately 4·2 x 3·2 x 2·3 centimetres. The apex is bifid, and the ventricles are equally represented on the anterior surface.

The right atrium is dilated, yet is normal in all respects, except that the foramen ovale is widely patent. No abnormality is present in the left atrium.

Of the two ventricles the wall of the right is thicker. A defect in the upper end of the interventricular septum allows the blood

in each chamber to mix, this blood subsequently passing into the aorta, which bestrides the two ventricles. The aorta possesses a normal complement of valve cusps, and the coronary vessels leave the parent trunk just above the valve.

In comparison with the aorta, the pulmonary artery is inconspicuous, the respective diameters at the widest parts being 9 millimetres and 5 millimetres. Both the infundibulum and conus are incorporated in the anterior wall of the right ventricle, and their topographical representation is on the left of the anterior longitudinal sulcus. The pulmonary valve is normal, and further on, the ductus arteriosus, which is pervious, leaves the main vessel at the bifurcation of the channel, where the right and left pulmonary arteries commence.

There is no defect in the diaphragm, and except that the kidneys and suprarenals are small, and that the liver rises to the level of the third rib anteriorly, the abdominal viscera appear normal.

Description of the central bulge.—Inspection removes the impression that there is a single median eye. The palpebral margins provide a clue in that a concavity is present almost in the middle of the inferior lid, though no ridges or depressions mark the conjunctival surface. Eccentrically placed, and slightly to the left of the midline, is an iris, approximately equal in size to the lateral irides. On retracting the eyelids another iris is seen in

FIG. 2.

The fused eyes viewed from the right supero-anterior aspect.

the upper and right quadrant. The corneae over these two irides are continuous, the corneo-sclerotic junctions taking the form of an hour glass. The illustration (Fig. 2) shows this well in addition to revealing strabismus, the axes of the eyes making an angle of 20 degrees in front.

A block containing the two eyes exhibits maximum peripheral fusion at the corneal area. In a sagittal plane, a moderately deep annular groove extends around the junction of the eyes and becomes flattened near the cornea. A common lateral rectus muscle serves both eyes, though it is attached principally to the

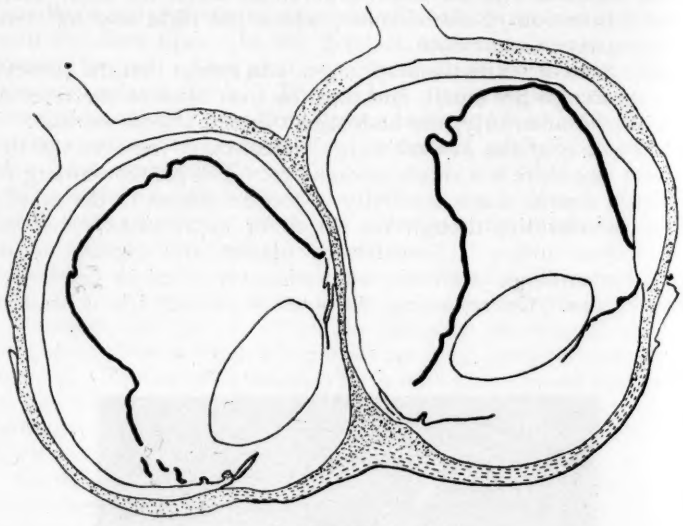

FIG. 3.

A diagram of the hemisected fused eyes showing the sclerotic partition.

smaller eye, which incidentally receives the larger of the two optic nerves. More than half of the cornea of the smaller eye is buried in the fusion, whereas the limbus of the larger is just covered.

Histological description.—The transition from sclera to cornea is clearly defined in the larger eye, being demarcated by large vessels. When the sclera is traced back it is found to become thin and compact at the junction of the two eyes. The large vessels at the junction probably indicate the anterior limit of the common sclera; over the front of this the cornea is continuous. Bowman's membrane extends from the extremity of one cornea to the outer edge of the other cornea and crosses the point of junction, where

it is less well defined. In the smaller eye, deep to Bowman's membrane, are vessels which do not extend quite as far as the junction of the two corneae. The substantia propria of the smaller eye loses its lamination at the point where the two corneae are incompletely separated. Descemet's membrane and the endothelium of the smaller eye appear to end abruptly at the junction of the substantia propria and the sclera. From this point to the angle, the anterior chamber is lined by a thin membrane. Posteriorly, the common sclera separates into two parts corresponding to each eye. The vessels of the choroid coats are large and full, but there is no abnormality of the retina. A wide gap intervenes between the two optic nerves.

Radiographical examination: There is duplication of the upper six cervical vertebrae and of the jaws. Hemi-vertebrae may be

FIG. 4.

The lateral and anterio-posterior radiographs of the monster. The arrows point to the hemi-vertebrae.

seen at the level of the 10th and 12th thoracic segments. The skull is typical of anencephaly. The lateral radiographs dispose of the impression gained from the antero-posterior aspect, that the femora and tibiae are achondroplasic.

Acknowledgment.—Thanks are offered to Dr. Abbie for assistance with the histology; to Dr. Oxenham for interpreting the radiographs; and to Mr. Woodward Smith for the photographs.

THE SCHOOL OPHTHALMIC SERVICE

BY

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THE eye and the ear are the chief gateways of learning, therefore defects here are of prime importance. Impaired eyesight is one of the commonest and most potent defects which stand in the way of a child's school education. A service for the treatment of a particular condition or defect can only be made comprehensive by an efficient organisation in which the ascertainment of children suffering from that defect is complete. The earlier the ascertainment, the better the results of treatment. This applies to many other conditions besides defective vision, crippling defects being a good example. It is very important that arrangements should be fully developed for the ascertainment of defective vision and eye disease in children below school age. In the case of children under five years of age suffering from these defects the chief means of ascertainment is by the home visits of Health Visitors of the Maternity and Child Welfare Authority. The health visitors visit all homes (with the exception of the well-to-do) within fourteen days after the birth of the child, and thereafter periodically up to the age at which the child enters school. The health visitor inquires into the general condition of the child, and invites the mother to attend the infant welfare centre where an examination by a medical officer would be carried out. In the course of this work, the health visitors would become aware that a child was suffering from blindness, obvious squint, and inflammatory disease of the eye, and such a child would be referred for examination and treatment. Children known to be suffering from severe defective vision or eye disease should be notified to the Education Authority before admission to school. The Education Authority is then forewarned and can make suitable arrangements for any special medical or educational treatment at the earliest possible moment. In rural areas the health visitors can

only visit the homes at infrequent intervals, and in any case children with only moderate or slight degrees of defective vision are not likely to be detected. Even in these areas, however, cases of blindness, severe squint and severe disease of the eye become known and are offered facilities for treatment. In the case of school children suffering from defective vision the most important means of ascertainment is the system of school medical inspection. The flaw in this system lies in the fact that as a rule vision is not tested until the second routine inspection, *i.e.*, when the child has reached the age of eight. The work of the school nurse is a valuable supplement to the sifting-out process performed by school medical inspection. The school nurse visits the school, in most areas, not less than three times a year, and in others considerably more frequently. During these visits she should be on the look-out for children suffering from eye disease or showing symptoms of defective vision.

Any such children must, of course, be referred to the school doctor for more detailed examination. The work of the school doctor and the school nurse in the ascertainment of children suffering from these defects can be made effective only by the active co-operation of the teachers. The teachers are in daily touch with the children and are in a more favourable position to detect symptoms indicative of a defective special sense than is a school doctor who sees the child only occasionally. Thus if a teacher notes that a child holds the book too close to the eyes, or sits in a stooping position at the desk, or complains of not being able to see the blackboard, or is backward, he should refer the child to the school medical officer for early examination. Similarly, children with inflammatory eye disease, or with squint can be detected by the teacher, who should refer them for special attention. The value of the teacher in our scheme of treatment will be dealt with in detail under "following-up."

Before describing visual acuity and how it is tested in the schools, a short account will be given of sight in young children.

Vision in Young Children

The child gradually appreciates varying degrees of brightness, learns to focus on near or distant objects by the effort of "accommodation," acquires stereoscopic vision, and judges distance and colour. The development of these processes is slow and conforms, with due allowance for differences in individual children, to a more or less definite pattern. The growth of the eyeball is most rapid in the first two years of life, and by the age of seven it has almost attained its maximum size. A great amount of this growth is due to increase in thickness of the coats of the

eye, though the increase in the diameter of the cornea between birth and maturity is only 2 mm., or approximately 20 per cent. This increase occurs almost wholly during the first two years of life. The rapidity of growth displayed by the eyeball is even more noticeable than that of the brain, and it is not surprising that the eye should be peculiarly susceptible to injurious influences during early childhood. The process of adaptation which enables the eye to focus rays of light from near as well as from distant sources is known as "accommodation." Most orderly muscular efforts, such as those involved in walking and respiration, involve the alternate use of antagonistic sets of muscles. "Accommodation" for near vision is, however, peculiar since it frequently involves sustained muscular effort extending over a considerable period of time. The muscular effort entailed in continued reading is of a type comparable with that required to hold the arm up for a long time, and symptoms of ocular fatigue may therefore be frequently observed in school children. The normal eye, if overworked, may suffer from fatigue, and such fatigue is likely to occur even more readily in children who have an error of refraction; they are working under a visual handicap. Among the ordinary symptoms of eyestrain are headache, frowning, twitching, blinking, and rubbing of the eyes. There may be, in addition, some inflammation of the external parts of the eye, as blepharitis and conjunctivitis. These external eye diseases are by no means invariably due to eyestrain; they may be produced by external infection—dust and dirt, by bad nutrition, or by uncleanliness. Since, however, the lymphatic drainage of the eyeball is hampered by sustained ocular effort, such conditions will always tend to be aggravated when any eyestrain is already present.

The Visual Acuity—Snellen's Test

Under the school medical service the usual procedure is to test children with Snellen's long-distance chart, as a preliminary to refraction by the eye specialist.

The test is usually carried out by school nurses before or at routine inspections in the school. Care should be taken that the illumination of the chart is adequate (the illumination should be at least 10 foot-candles), that the child does not face bright light while being tested, and that the distance from the chart is 20 feet or 6 metres. The standard adopted in most areas is that if a child can read no further than the fifth line (6/12) with either eye he is referred for full ophthalmic examination. If, in addition, all cases showing symptoms of eyestrain, no matter what the visual acuity is, are referred, the majority, though not all, children in need of ophthalmic supervision are

picked out. It should be pointed out, however, that the application of a visual acuity standard does miss a few children, namely, young children with low hypermetropia and emmetropia, who may become myopic later and for whom ophthalmic supervision over a period is desirable. The Board of Education's Committee on Defective Vision (1931) emphasised three main points:—

"(1) The comparative rarity of emmetropia (normal condition) at any age, the condition being observed in only 2-3 per cent. of children at the age of admission to school. Although its incidence increases with age it does not exceed 10 per cent. among children about to leave school.

"(2) The rarity of myopia (short sight) in children under 5 and the gradual increase in incidence as age advances.

"(3) The great preponderance of hypermetropia (long sight) and even of high hypermetropia at all ages, though the incidence diminishes as age advances."

These conclusions enable us to infer that the eyes of children are in a dynamic state; that at birth the normal condition is one of hypermetropia, which is converted as time goes on to one of emmetropia; and that over-action in this otherwise physiological process produces a condition of myopia.

The Chief Medical Officer of the Board (1931) writes: "What factors favour this over-action and what differences there are in the process which produces the myopia of slowly progressive type, and that which produces the pathological type which may be accompanied by degenerative changes such as haemorrhage, choroiditis and detachment of the retina, are problems which need further investigation." The Committee previously referred to found that although myopia of even slight degree usually gives rise to some visual defect, the latter may not be of sufficient extent to ensure that all cases are examined by refraction. Similarly, hypermetropia may be of moderate extent, even up to three dioptres, without giving rise to a visual disability severe enough to refer the case for fuller examination. The correction of moderate hypermetropia of children by the provision of spectacles may be of little importance, but it is unquestionable that all cases of myopia, however slight, should be kept under observation. Emmetropia, too, which, if the inference concerning the dynamic state of children's eyes be correct, may be a stage in the conversion of the hypermetropic to the myopic eye, should be regarded with suspicion in cases where there is a family history of myopia. It is evident therefore that under examination by Snellen's long-distance chart on which we base our preliminary selection of children for refraction by the eye specialist, a certain number of visual conditions requiring observation and possible treatment are missed until the visual acuity defect becomes so pronounced

as to cause the child to be brought before the ophthalmic surgeon. The only method of completely overcoming this defect in the system of ascertainment would be to arrange that every child, soon after admission to school, is examined by refraction. This perhaps sounds an ideal, though it does not appear to be outside the realm of practical reality. The examination would need to be carried out only once in the school life of the large majority, for most children would reveal a normal condition of eyesight and therefore they would be exempt from re-examination.

Another defect in the system is that children are not subjected to a test of visual acuity until the age of eight. This can be overcome partly by the use of special charts, *e.g.*, the E chart for illiterate children, though testing by such charts is tedious and the results are unreliable unless the test is carried out by an expert. The variable E test card, *i.e.*, one in which the E signs can be rotated in any desired direction, although an old method, is suitable for many purposes. The children should be drilled to turn their extended fingers into the position of the limbs of the E shown. This method of examination has been proved by tests with mentally defective children to require the smallest degree of mental work. No recognition of an arbitrary character, or naming of a sign, is required, only the minimal capability of imitation, and the power to put the fingers into the position of the E shown. No words are required, only the motion of the hand. The Board regard this as the best test card to use when selecting children for admission to blind schools.

Another method is to arrange that nurses in their periodic visits to the schools should test the vision of those children who have learnt to recognise letters, *i.e.*, children between the ages of six and seven. This method is carried out in some areas.

Dr. A. S. Simpson, S.M.O. of Stalybridge, writes in his Report, " I have included an additional routine visual inspection of the six-year-olds, or children who have been in school for a year. 305 children of this group were examined for visual defects and resulted in 35 children being found to require treatment, whilst 10 required to be kept under observation.

In Leeds, nurses undertake the work of testing the five-year-old group either by reading or by matching, and as a result of such testing in 1933, 220 children of various ages under six were noted as requiring refraction, and 328 as requiring to be kept under observation. This means that approximately 550 cases of defective vision which in ordinary cases would not be ascertained until the age of eight were found.

Returning to the E chart for young children and illiterates I should have mentioned that the chart is utilised fairly extensively in the testing of pre-school and young children, from three years

old upwards in certain cities of America, notably Pittsburg and Philadelphia. This work is actively encouraged by the National Society for the Prevention of Blindness, who regard the early correction of errors of refraction as a very important factor in the pursuance of their policy. Even admitting the impracticability of using the E chart in a routine examination of infants, and the unreliability of the results obtained from it, it still remains a matter of importance that some visual test should be applied to children at the earliest possible age. If the nurses in their periodic visits to the schools tested the vision of children of 6+, as previously stated, it would fill in that hiatus which exists between the time when the child is admitted to school and the intermediate (second-age group, 8 year old) medical examination, and secure examination and appropriate treatment by an ophthalmic surgeon of many cases of defective vision, which in the ordinary course of events would not be discovered until one or two years later. Some years ago the Board suggested that school medical officers should give this matter their earnest consideration, and investigate the practicability of making a test of visual acuity of children at an earlier age than is done under the present system.

Examination and Treatment

The following are the principal activities which are comprised under the heading " Examination and Treatment ":—

(a) Examination and treatment of defective vision due to errors of refraction.

(b) Examination and treatment of squint.

(c) Examination and treatment of children suffering from diseases of the eye.

(d) Selection, treatment, and supervision of "partially-sighted" and "blind" children.

(e) Testing of colour vision by group and individual tests.

The latter condition has formed the subject of an Article which has appeared elsewhere, so will not be considered here.

(a) *Examination and treatment of children with defective vision due to refractive errors.*—This forms by far the greater part of the work undertaken by the ophthalmic branch of the school medical service. The work may be discussed under two heads:—

(1) Refraction and ophthalmic examination.

(2) " Following-up " the children who have been treated.

(1) It is essential that the child be prepared for the examination by the instillation of a mydriatic into the eyes. Actual details vary according to the individual surgeon. Atropine ointment is the mydriatic usually preferred, and it is applied for about three nights and mornings, before the examination, but not the morning of the examination. The ointment may be applied daily by the

nurse at the clinic, or it may be applied by the parent at home. Some authorities regard its action as too prolonged for school purposes. In country districts where distance renders daily attendance at the clinic difficult, homatropine instilled shortly before the examination is used, though this is uncertain of producing complete paralysis of accommodation in young children. Some authorities regard homatropine and cocaine, 2 per cent. solution, used three times at ten minute intervals, as the best mydriatic. The refraction is usually carried out in a school clinic specially fitted-up for this purpose. Full records of the refraction, the condition of the fundus and, if prescribed, the spectacles, should be made at the time of the examination. In the case of myopia a large number of records were surveyed, and it was found that in many cases of moderate or even high conditions of this defect, no record of the fundus condition was made. The Board state " This may be due to the pressure of work of ordinary school clinic work, but it would be more satisfactory to have the assurance that this important part of eye examination is not being overlooked. Another fact of importance and interest is that a considerable number of the records surveyed show that myopes, even of moderate degree, were emmetropes or low hypermetropes during early school life."

The Board's Committee on Defective Vision about 8 years ago suggested tentatively a modification in the Snellen's long-distance test by which it might be made to yield results of greater value. Under present conditions if a child reads 6/6 or 6/9 he is, unless he has subjective symptoms, passed as being normal, yet he may be hypermetropic or slightly myopic. Before recording such a case as normal or not needing correction, the examiner should place a +1·0D. sphere before the reading eye. If the eye is hypermetropic it will still read 6/6, or possibly even more easily than before. If it is emmetropic or myopic the visual acuity will become less than it was before and in the latter case may diminish to 6/36. Thus the observer should be enabled to make a more accurate and complete ascertainment of those cases which need a fuller examination by retinoscopy, or continued supervision, which under ordinary practice escape detection until their visual defect becomes so obvious as to be recognisable by the ordinary tests at present employed.

The procedure just described was tried out by Mr. Frank Law, F.R.C.S., the Council's Oculist at Willesden, and by Dr. E. L. Roberts, Assistant S.M.O. of Heston and Isleworth. From the experience gained in these two areas it was evident that further trial was necessary, in order to determine the practicability and usefulness of this measure, or a modification of it, in the ordinary routine of school medical inspection.

Dr. Carr, school oculist, Derbyshire, put the case of ophthalmic work very succinctly some years ago, " The primary objects of a school ophthalmic service must be the preservation of sight, that is to say, preventive; and the amelioration of defective vision already existent, that is to say, curative. The correction of refractive errors constitutes a preponderating proportion of the work of the ophthalmic surgeon, but it is by no means the most important. A correctly prescribed pair of glasses will improve a patient's vision, or enable him to use his eyes with greater comfort, and very often will do both, and may even have a remarkable effect on his health and ability to profit by instruction, and thereby on the whole of his future career. But by treating a corneal ulcer and getting it to heal before it has done irreparable damage, or by operating on a cataractous eye, the oculist has the satisfaction of preventing blindness in the first instance and of curing it in the second."

(2) Following-up children who have been prescribed glasses. The successful working of arrangements for the treatment of children suffering from defective vision depends on large measure on the efficiency of the arrangements for " following-up " individual children by the school nurses. The importance of this work and the value of the teachers' help will be dealt with in detail. The nurses must keep in touch with children for whom spectacles are prescribed in order to make sure that such spectacles are obtained. Children who require periodical examination, *e.g.*, those with myopia, should attend the clinic at the appropriate intervals determined by the ophthalmic surgeon. The nurses must inspect during their periodic visits to the schools, children for whom spectacles have been provided in order to ascertain whether those children are wearing spectacles, or whether any children through loss or damage need new spectacles.

During their visits to the schools they should test the visual acuity of all children with spectacles at least once a year, and refer any children with a change for the worse in visual acuity for full examination. The teacher is invaluable in this system of " following-up." In most areas it is usual to provide head teachers with lists of children who should be wearing spectacles and to ask for their co-operation in seeing that the children wear them, and in referring any children, who have broken or lost their spectacles, to the clinic. Thus the teacher is important in inducing children for whom spectacles have been prescribed to get them, and wear them. Children, through forgetfulness or intention, fail to bring their glasses to school; glasses by accident or carelessness get broken. These untoward incidents can be avoided or corrected by the teacher, the first by the exercise of discipline, the second by the immediate reference of the case to

the clinic or medical officer. Without action on her part, children who ought to be wearing spectacles may remain without them for an indefinite period and much harm may result as a consequence. Educational backwardness and disability is one of the symptoms of defective vision. The teachers alone are in a position to recognise this symptom, and their duty is to refer all children who fail to keep up with the normal classwork for full examination by the medical officer, assisting him with their knowledge of the child's visual disability and of any signs of headache or neurotic conditions.

Two other points will be dealt with here, although not strictly belonging to this section. Conditions in the classroom should be made to conform as far as possible with the general principles of hygiene of vision. Attention should be paid to lighting, to the position of blackboards, desks, and books in relation to the posture of children at the desks, and to the position in the classroom of children who suffer, or are suspected of suffering, from defective vision. The second point is that even an apparently simple procedure such as vision testing may have its pitfalls, for apart from the obvious essentials, too often neglected, such as suitable lighting, height of the test card, proper technique on the part of the observer, due regard must be given to the psychological " make-up " of the child. It has been known for a long time that defective lighting of classrooms may contribute towards the production of visual defects or may at any rate have a detrimental effect on defects already existing, but the exact amount of injury due to this factor is as yet by no means clear. Many school doctors have explored this subject. Some years ago the school ophthalmologist of Leicestershire, Mr. C. Walters, inspected a number of schools and he considered that in seven of them the lighting was defective. Four of these were amongst six schools showing the highest percentage of children wearing glasses. He found, of course, that the correlation between defective lighting and a high percentage of children wearing or requiring glasses was by no means exact, but the following table from a report made by him at the time suggests a relationship :—

School conditions, lighting, seating accommodation.	Total number of children.	Number wearing glasses.	Percentage wearing glasses.	Number suffering from eye-strain.	Percentage suffering from eye-strain.
Good ...	2,281	156	6·7	129	5·6
Defective ...	1,686	147	8·7	181	10·7

In concluding this section it can be said that in no branch of the work is this co-operation of the teachers more needed in the prevention, ascertainment and treatment of visual defects in school children.

Dr. Allardice reporting to the Wakefield Education Committee gave details of what appear to him to be the essentials of a complete ophthalmic scheme and his recommendations arise from the desire to secure the detection of defects at an early stage when treatment could be more effective and would have greater preventive value. His scheme is this:—

(1) The care of the eye-sight of the expectant mother at the ante-natal clinic;

(2) The treatment of ophthalmia neonatorum at the infant welfare clinic;

(3) Ophthalmic examination of all entrants to school;

(4) Reference of external eye disease to minor ailment clinic;

(5) Routine refraction work at 8 and 12 years of age;

(6) Regular re-examination;

(7) Tests for colour blindness;

(8) Use of the open-air school for myope classes;

(9) Continuous attention to children entering on secondary education and those beyond 14 years of age.

Many reports of school doctors contain practical recommendations in regard to vision defects and their remedies, by far the largest group of " school diseases " and in some ways obviously the most important.

Dr. Wray, of the Lancashire County Council, has made a special study of the aetiology of defective vision. He concludes:—

(1) That heredity plays a large part in the production of errors of refraction due to mixed astigmatism, and that the maternal influence is the more potent one in passing on the defect to the next generation. 38·2 per cent. of the parents of children affected by mixed astigmatism showed evidence of visual defect; 49·8 per cent. of the cases affected with this defect showed visual defect amongst other members of the family. Brothers or sisters of the cases examined showed myopic errors frequently, but hypermetropic errors were also found. The familial predisposition to this defect or other defects of sight was found to be about 50 per cent.

(2) More cases of this defect are found in older children, and more frequently in girls than in boys, conditions which are also found in myopia.

(3) More cases are found in schools where lighting is defective.

(4) More cases are found in country schools than in urban schools.

(5) Close relationship between the parents is a potent factor in producing this defect.

(b) *Examination and treatment of children with squint.*—The successful treatment of squint involves not only the correction of the deformity but the restoration of the function of the squinting

eye and the re-establishment of binocular vision. Orthoptic treatment by means of the amblyoscope and other instruments has come to the fore of late and is used by an increasing number of authorities. Treatment to teach eyes to act together is carried out by exercises with the amblyoscope. In the case of "squint classes," which have been doubled during the last few years, the error of refraction is carefully corrected and the child is transferred to the squint clinic for treatment to restore the sight of the squinting eye. Vision with glasses is tested, and where the visual acuity of the squinting eye is found to be less than that of the good one the fixing eye is carefully occluded. The only reliable occluder is a black silk patch fixed to the skin with strips of elastoplast leaving a small lower temporal air vent. If the glasses are constantly worn and the good eye is not used, a slow but sure improvement in sight is obtained. When the sight of the bad eye is 6/9, a film of soap is applied to the glasses instead of the paper. The good eye is not uncovered until the sight of the bad eye has improved to its limit. Another treatment consists in utilising a supplementary attachment holding a prism of calculated strength which can be fitted over one or both lenses of a pair of spectacles. The Board cannot regard an ophthalmic scheme as complete without the formation of special arrangements for the treatment of squint and for exercises in fusion training. Further, they state it is essential that such arrangement should be made to apply to children below school age when the chances of obtaining a satisfactory result, particularly as regards the restoration of the function of the squinting eye, are much more promising than when the child is older. Dr. Parry, the S.M.O. for Bristol, wrote (1934): "Cases of squint are detected and treated in as early a stage as possible. Strabismus found in children under school age is reported by members of the Infant Welfare Department, to whom we are indebted for much valuable assistance in this way. A total of 161 new squint cases . . . attended during 1934. Of new cases 85 were under school age and were mostly referred by the Infant Welfare Department."

All children with strabismus should be re-inspected by the eye specialist say at three monthly intervals, and kept under regular supervision.

Myopia

Myopia generally first shows itself from the age of 8, when school work begins in earnest—that is, when convergence is first used in excess. Donders reached the classification that myopia exists in three forms—a stationary, a temporarily progressive and a continuously progressive. Dr. Gimblett in the

East Ham School Medical Officer's Report for 1929 wrote that comparatively few cases were noticed during the first year of school life, more appeared in the second, but by far the greater number were discovered between the ages of eight and twelve.

Dr. Gimblett is of the opinion "that the incidence of myopia is affected by *heredity*, *previous illness* (particularly the acute specific fevers), and *school competition.*" He observed that those schools distinguished by a high standard of education and competitive spirit have an incidence of myopia above the average of the other schools of the area. "Out of the 170 myopes, 35 or 20 per cent. were "scholars", while of the total school population of East Ham the "scholars" number 5½ per cent. It is interesting to note that both the incidence and progress of myopia varied directly with the standard of scholarship in the different schools. Out of the 170 cases 29 had fundal changes when they were first seen, in three of which they became more marked while the child remained under observation. In 15 cases at first free from changes, they appeared later. An examination of the summaries of these cases suggested that the presence of fundal changes is more closely related to the rate of progress of myopia than to the extent of myopia present. As a general rule children show myopia of a comparatively mild form, and though the incidence increases with the age of the child its severity seems to bear no relation to age, the severe cases being as common in the earlier age groups as in the later. Thus we can say that myopia does not manifest itself to any great extent during the early school life of the child, but becomes more common from the eighth year onwards. In many cases structural peculiarities in the eyes no doubt favour the development of myopia, but it is probable that other cases are directly due to conditions prevailing in the schools which cause undue eyestrain. Dr. James Kerr, many years ago said: "Any child in an elementary school with marked myopia, unless the myopia can be retarded, is in a very dangerous condition as regards vision in later years." In this paper only the milder degrees of myopia are being considered. The higher degrees causing the child to be regarded as "partially-sighted" for educational purposes, will be dealt with in another paper. In the case of a child suffering from "educational" myopia it seems hardly fair to place him under the limited educational opportunities of the special class. On the other hand, does the curriculum and competition of the ordinary school tend to convert the "educational" into the "pathological" myope? The Chief Medical Officer of the Board writes: "How are we to distinguish clinically the early phase of the 'pathological' myope from the 'educational' myope? This is an important point and requires special consideration with a view to modification of the education the

child receives in the ordinary school or in a school for 'partially-sighted' children." It is interesting to note that in "myope" classes only about one-third of the children are myopes. It is thus a misleading and inaccurate name.

(c) *Examination and treatment of children with diseases of the eye.*—This branch of an ophthalmic service has particular importance as regards the prevention of defective vision and even of blindness in that it deals with eye disease. At the outset it should be mentioned that the majority of cases of external eye disease, such as conjunctivitis, blepharitis, corneal ulcers, corneal abrasions, keratitis, styes, foreign bodies, etc., are referred in the first place to the minor ailment clinics, and practically all are treated there. In the case of severe inflammatory conditions and chronic states, the child is referred to the special ophthalmic clinic. Here the case will come under expert examination and advice. A few cases, *e.g.*, interstitial keratitis, may need treatment at a hospital or special clinic. In some cases, such as intractable blepharitis or phlyctenular conjunctivitis, the children often receive considerable benefit by a stay in a residential open-air school. Occasionally prolonged treatment under hospital conditions are required on account of the severity of the inflammation or the infectious nature of the disease, *e.g.*, trachoma. Up to three or four years ago the only special hospital school dealing with cases of this character was the White Oak Hospital for Ophthalmia, Swanley, Kent, an institution conducted by the London County Council.

The treatment of diseases of the eye by ultra-violet radiations is dealt with in detail in my book on "*Ultra-Violet Therapy.*" This briefly gives an idea of the work carried out by the ophthalmic service of a Local Authority. All authorities with one exception (Isles of Scilly, 183 children) have established ophthalmic schemes for the treatment of children with defective vision and eye disease. A few of the activities which should be included under a complete ophthalmic scheme have been mentioned. Though children of school age are the primary concern, a medical service of this character cannot be strictly confined to one section of the community; consequently, matters outside the strict scope of the school medical service have been taken into account. The ophthalmic service has an important duty to perform in the selection and supervision of children who, on account of defective vision, are in need of special educational provision, *i.e.*, "partially-sighted" and "blind" children. This part of the work will be dealt with in a future paper.

There are, of course, visual defects which do not depend on errors of refraction. Mr. Paterson, the school oculist to the Darlington Education Committee, reported a few years ago the

discovery of a number of cases of night blindness, the cause being xerophthalmia. The condition appears to have been quickly remedied by adding to the children's dietary an adequate supply of foods containing vitamin A. In all areas there are cases of children presenting ocular symptoms in whom an exhaustive examination discloses no physical defect. The percentage of such cases varies considerably in different places, but in Portsmouth, Dr. W. S. Inman found that 25 per cent. of children attending the Eye Clinic required no active treatment. They were mostly "nervous" children, and he discussed the question as to whether their symptoms were produced by disharmony of mind rather than of body, and concluded by saying: "Child guidance clinics are being formed in London, and it cannot be long before they exist in every educational centre in the country. One method of recognising the nervous child will be by the disparity between the severity of the symptoms and the condition of the eyes. A happy, healthy child does not complain without just cause. If an ocular cause cannot be found and no other adequate organic explanation of the symptoms is present the aid of a psychological department should be available."

At Liverpool in 1929 an exhaustive investigation of hereditary optic atrophy (Leber's disease) was carried out, and the findings gave accurate information as to the transmissibility of this serious defect. The results of this investigation have been summarised and are as follows:—

(1) The disease is transmitted according to Mendelian laws of heredity appertaining to dominant and recessive characteristics, and is attributable to a dominant factor. Consequently, in the event of the marriage of any affected case with a normal individual, it is possible to predict that approximately half the offspring will also develop the disease. Further, in the case of unaffected members, it is quite safe for them to marry as the disease will not be transmitted to their descendants.

(2) The disease is not sex limited as was formerly thought, both males and females suffering from and transmitting the disease in approximately equal proportions.

(3) So far as the cases in which it has been possible to make a personal investigation are concerned, the disease has manifested itself in childhood and the onset is not delayed until adult life, as was thought by Leber.

The Board consider it essential that there should be on the staff of the ophthalmic service an ophthalmic surgeon of consultant standing. Not only is he an adviser, but also an executive officer in so far as he carries out treatment of certain special cases. Most of the work of an ophthalmic service is carried out by full-time officers on the staff of the school medical service. Many children

with defective vision due to simple errors of refraction are treated by assistant medical officers who have had the requisite experience. It is advisable, however, that all treatment for defective vision be carried out by officers specially qualified and with special experience. There are certain duties under the ophthalmic scheme which should always devolve upon the specialist. They are as follows:—

(*a*) Examination and treatment of all cases of myopia.

(*b*) Examination and treatment of all cases of defective vision due to complicated errors of refraction which will be referred by assistant school medical officers.

(*c*) The supervision of clinics for the treatment of squint.

(*d*) Examination and treatment of all cases of severe and protracted eye disease.

(*e*) The selection, examination and supervision of all " partially-sighted " children.

(*f*) The certification of children as " blind " under the Education Act and the supervision of such children.

(*g*) The certification of adolescents under the Blind Persons Act.

Education Authorities Schemes for dealing with visual defects are complete (only one Authority does not make provision) throughout the country, and there is hardly a child who has not the opportunity to have such defects corrected. The number of children examined by ophthalmic surgeons during 1936, the last year for which a Report is available, was over a quarter of a million, which represented over 5 per cent. of the total school population, an indication not merely of comprehensive treatment but also of the systematic re-examination necessitated by alterations in the vision of individual children. It would be fairly safe to say that only a very small proportion of children leave school without having their visual defects corrected so far as human skill can do this.

TABLE I

Tables showing the Staff and work done under the Ophthalmic Schemes of Local Authorities during the year 1936.

SPECIALIST STAFF.

	Specially appointed Ophthalmic Surgeons	M.O.'s and A.S.M.O.'s
Counties - - -	145	84
Boroughs - - -	108	48
Urban Districts - -	20	6
County Boroughs - -	80	92
London - - -	59	—
TOTAL - -	412	230

TABLE II

Incidence of Defective Vision and Squint, 1936.

TYPE OF AREA	Number of children inspected at routine inspections (entrants excepted)	Number of cases of defective vision requiring treatment			Percentage of children with defective vision and squint
		Errors of Refraction	Squint	Total	
Counties - - -	438,290	31,153	4,743	35,896	8·2
Boroughs - -	161,365	11,206	1,732	12,938	8·0
Urban Districts -	30,099	2,737	502	3,239	10·8
County Boroughs -	384,912	29,795	5,411	35,206	9·1
London - - -	134,225	12,768	946	13,714	10·2
TOTAL -	1,148,891	87,659	13,334	100,993	8·8

TABLE III

Number of cases of Defective Vision and Squint and other Eye Defects dealt with during the year 1936.

TYPE OF AREA	Defective Vision and Squint			Other Eye Defects		
	Under Local Education Authorities' Schemes	Otherwise	TOTAL	Under Local Education Authorities' Schemes	Otherwise	TOTAL
Counties - -	86,046	2,881	88,927	2,465	113	2,578
Boroughs - -	34,517	1,114	35,631	1,469	139	1,608
Urban Districts -	7,876	205	8,081	472	29	501
County Boroughs	91,088	3,412	94,500	1,939	172	2,111
London - -	37,570	1,006	38,576	2,000	—*	2,000
TOTAL -	257,097	8,618	265,715	8,345	453	8,798

* The figure for these defects is included in another Table.

TABLE IV

Provision for treatment of Defective Vision by Local Education Authorities.

	Counties	Boroughs	Urban Districts	County Boroughs	TOTAL 1936	Number not making provision in 1936
(1) Treatment of Defective Vision -	62	146	24	83	315	1
(2) Supply of Spectacles -	61	145	24	83	313	3

TABLE V

The number of School-Clinics provided by Local Education Authorities for the treatment of Defective Vision and Squint during the last ten years is as follows:

YEAR	Number of Clinics	YEAR	Number of Clinics
1927 - - -	569	1932 - -	660
1928 - - -	593	1933 - -	673
1929 - - -	606	1934 - -	670
1930 - - -	633	1935 - -	694
1931 - - -	644	1936 - -	718

TABLE VI

Number of Hospitals with which Local Education Authorities have made arrangements for the treatment of defects of vision, year 1936.

	Visual Defects		
	Refraction	Other Treatment	
		Operative	Non-Operative
Number of Hospitals -	67	84	42

ANNOTATION

Ophthalmic Casualties in Air Raids

It seems that in the event of air raids the special hospitals in the London area and other large centres will be commandeered for the treatment of casualties of all kinds and that their rôle will be similar to the general hospitals.

It is desirable that ophthalmic casualties should be dealt with by units trained for this work and that they should be evacuated from the theatre of air raids at the earliest opportunity after appropriate treatment has been applied. There is no need for any ophthalmic case to remain in the danger zone. Gas cases and minor injuries

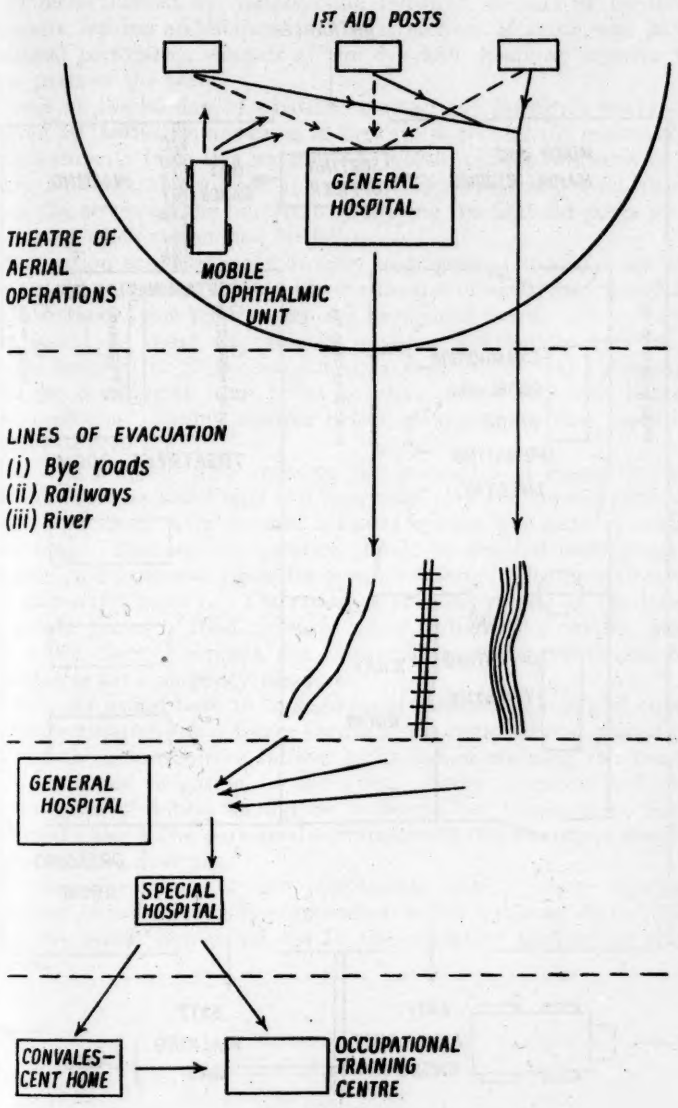
1ST AID POSTS
GENERAL HOSPITAL
THEATRE OF AERIAL OPERATIONS
MOBILE OPHTHALMIC UNIT
LINES OF EVACUATION
(i) Bye roads
(ii) Railways
(iii) River
GENERAL HOSPITAL
SPECIAL HOSPITAL
CONVALES-CENT HOME
OCCUPATIONAL TRAINING CENTRE

FIG. 1.

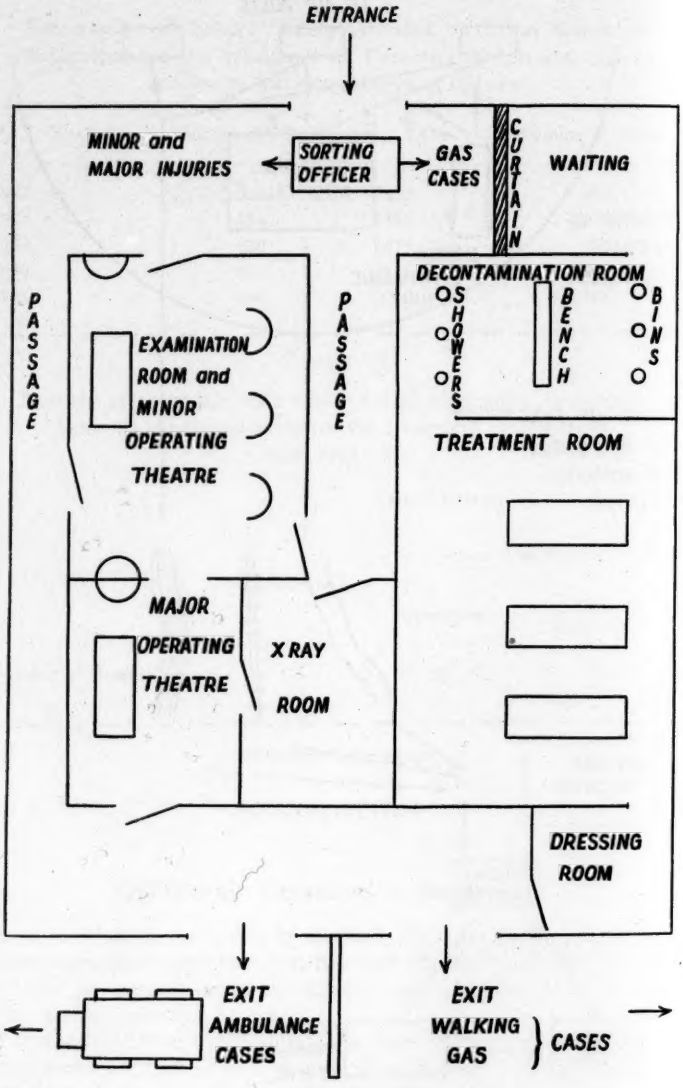
ENTRANCE
MINOR and MAJOR INJURIES
SORTING OFFICER
GAS CASES
CURTAIN
WAITING
DECONTAMINATION ROOM
SHOWERS
BENCH
BINS
PASSAGE
EXAMINATION ROOM and MINOR OPERATING THEATRE
PASSAGE
TREATMENT ROOM
MAJOR OPERATING THEATRE
X RAY ROOM
DRESSING ROOM
EXIT AMBULANCE CASES
EXIT WALKING GAS
CASES

FIG. 2.

could be evacuated by underground railways, in cars or by river transport, leaving ambulances for the stretchers of those who have sustained perforating wounds of the eye and disabling injuries to other parts of the body.

Some of the burden of casualty work in the hospitals could be relieved by treating minor cases at first aid posts and the evacuation of such directly from this source. A mobile ophthalmic unit in a motor ambulance equipped for ophthalmic operating would also lessen the strain on the hospitals by touring the first aid posts in a given area when summoned for help.

Evacuation could be made directly to general or special hospitals situated 20 or more miles outside the theatre of aerial attack and at a safe distance from main roads, rail heads and rivers.

It would be more desirable to have an ophthalmic unit in a general hospital or if necessary near a general hospital. Patients could be discharged from these hospitals to convalescent homes or occupational training centres before returning to their place in military or civil life.

Fig. 1 is a rough plan showing the principles of evacuation of ophthalmic cases and Fig. 2 is a suggested plan for the reception of ophthalmic cases at a general hospital within the zone of aerial operations. This reception station should be situated underground and adequate provision made for possible failure in the main electric light and water supply. The entrance and exit should be rendered gas proof. Stores of food, drinking water, cylinders of oxygen, pick axes, ropes, electric torches, fire extinguishers and sand should be in readiness for emergency measures.

Gas cases would have to be segregated from the others and enter a decontamination room where clothing was removed and placed in bins and the patients have shower baths before entering the treatment room for irrigation of the eyes. Large irrigators holding several pints of lotion should be mounted on stands near each treatment chair. The personnel administering this treatment should be protected against gas.

In the other part of the ophthalmic clinic, minor injuries, extraction of intra-ocular foreign bodies, repair suturing of wounds of the eye would be carried out in the operating theatre for that purpose.

ABSTRACTS

I.—UVEAL TRACT

(1) **Jahnke, W. (Stettin).—Experimental investigation of the condition of ectogenic iritis. (Experimentelle Untersuchungen ueber das Zustandekommen der ektogenen Iritis).** Klin. *Monatsbl. f. Augenheilk.*, Vol. C, p. 362; 1938.

(1) **Jahnke** describes some most interesting experiments to prove that the ectogenic iritis which accompanies an irritative condition of the cornea or conjunctiva, originates not by chemotaxis as was originally supposed, but through an axon reflex. Local application of mustard oil to the cornea in rabbits produced localised hyperaemia of the iris in the corresponding quadrant.

Section of the ophthalmic branch of the trigeminal nerve prevented the reaction after sufficient time had elapsed for degeneration of the sensory nerve fibres, but the reaction could still be elicited a short time (3 days) after the section, which indicated that it was dependent on an axon reflex, peripheral to the Gasserian ganglion.

Section of all the nerve fibres in the chosen quadrant in the region of the equator of the eyeball, did not prevent the reaction, thus proving that the centripetal and centrifugal paths of the reflex are situated between the equator and the limbus. The sympathetic and para-sympathetic nerve fibres play no part in the reaction, neither was the hyperaemia of the iris due to an increase in the blood supply. The actions of adrenalin, nicotine, atropine, cocaine and alypin were investigated.

D. R. CAMPBELL.

(2) **Farina (Milan).—Tuberculosis and syphilis in relation to chronic iridocyclitis. (Tubercolosi, sifilide ed uveit chroniche anteriori).** *Rass. Ital. d'Ottal.*, May-June, 1938.

(2) **Farina** thinks that many cases of chronic iridocyclitis are due to tubercle or syphilis; these cases are specially rebellious to treatment, and are often labelled "rheumatic." They are very prone to relapse; the underlying states, tubercle or syphilis, are not active but latent; they render the eye more easily attacked and less easily cured; if the specific interference is abolished, treatment of the iridocyclitis is more commonly successful. The author gives the histories of a number of individuals in whom, to ordinary examination, there seemed to be no such infection, who recovered only when specific treatment was given.

HAROLD GRIMSDALE.

II.—MEDICAL OPHTHALMOLOGY

(1) **McKee, S. Hanford (Montreal). — Recurrent intra-ocular haemorrhage in young adults (Eales' disease). Report of a case.** *Canadian Med. Assoc. Jl.*, August, 1938.

(1) **McKee's** case was shown at the meeting of the *Medico-Chirurgical Society* at Montreal General Hospital in December, 1937. After a brief epitome of previous papers he describes his own *case, that of a male, aged 24* years on the occasion of his first visit, in 1932. The history was one of sudden blurring of vision in the *left eye the day before. Up to the age* of 15 he had suffered from frequent epistaxis, but had been free since his 16th year. *His general health was good, his physical condition* practically normal and he did not suffer from constipation, though lassitude was present. *This man has been under observation ever since,* he has had repeated recurrences and his vision has varied from 6/9 to 6/36. *The right eye has kept normal throughout. The retinal* haemorrhages in the left eye have not been specially peripheral and they have usually been accompanied by haemorrhages *into the vitreous.* Local medication had no effect.

R. R. J.

(2) **Paton, E. Townley (New York).—Recurrent retinal and vitreous hemorrhages in the young (Eales' disease).** *Arch. of Ophthal.*, August, 1938.

(2) **Paton's** *article opens* with a quotation from Eales' original account of this disease in which it is ascribed to a neurosis of the circulatory system *in which there is vaso-motor* contraction of the alimentary blood vessels with compensatory dilatation of the systemic vessels, *especially those of the head* and retina. The condition is rare, the author having seen only 6 cases in the Manhattan Eye, Ear and Throat Hospital where about *29,000* patients with ophthalmic conditions are treated in a year. It is common in the male sex and more likely to affect *the left eye. The* patients are in apparently good health except for constipation and the only ophthalmoscopic sign is a noticeable distension of the veins at the time the haemorrhages occur.

F. A. W-N.

(3) **Gibson, Glen G.—Clinical significance of the retinal changes in leukemia.** *Arch. of Ophthal.*, September, 1938.

(3) This useful report of **Gibson's** is based on the retinal changes and laboratory findings of *22 cases of leukaemia.* In *2* cases the characteristic retinal changes appeared before the signs in the blood

were sufficiently advanced to warrant a diagnosis. The earliest and commonest sign was in the retinal veins, which became darker and fuller than normal. In advanced cases the veins came to resemble a string of sausages, owing to their being constricted at intervals. Differential diagnosis from other causes of enlarged veins as follows: (1) Congenital, the veins are normal in colour and the arteries usually show similar tortuosity. (2) Polycythaemia, the colour is cyanotic and the arteries are also larger and darker than normal. (3) Congenital heart disease, the arteries are normal, and the veins extremely cyanotic. Retinal haemorrhages were present at the first examination in 13 out of 22 cases, but the typical ones with a white centre were seldom observed in the earlier stages. The haemorrhages may be of almost any size or shape with the possibe exception of the small punctate type seen in diabetes. In two of the cases they were so numerous as to simulate bilateral thrombosis of the central retinal vein. A narrow white band on each side of the vein is sometimes seen and is due to diapedesis of the white cells. Although the disease may occasionally run its course without ocular signs, there is a fairly close relationship between the amount of retinal haemorrhage and the general condition of the patient, particularly with regard to the red cell count though there is no such correlation with the white cell count.

F. A. W.N.

(4) **Reiser, K. A. (Bonn).—Fundus haemorrhages in influenza. (Ueber grippöse Haemorrhagien im Augenhintergrund).** *Zeitschr. f. Augenheilk.*, Vol. XCII, p. 207, 1937.

(4) **Reiser** reports five cases of influenza in young adults showing retinal haemorrhages, and comments on the scarcity of similar reports in the literature on the subject. The haemorrhages appear early in the infection and heal rapidly. The findings of Fraenkel (1920) of retinal haemorrhages in 25 per cent. of patients who died of influenza are recalled.

ARNOLD SORSBY.

(5) **Hanum, S. and Brochner-Mortensen, K.—Kidney function in diabetic retinitis.** *Acta Ophthal.*, Vol. XVI, p. 396, 1938.

(5) **Hanum and Brochner-Mortensen** report that contrary to the heavy renal involvement found by many observers in patients with diabetic retinitis, their own series of 20 cases studied for creatinine, urea and uric acid excretion gave no clear indication of renal inefficiency, except in one case of nephrosclerosis.

ARNOLD SORSBY.

(6) **Bensten, K. G., Dalsgaard-Nielsen, E. and Möller, H. U.** (Copenhagen). **Sturge-Weber syndrome with special reference to the ocular symptoms. (A propos de la maladie de Sturge-Weber, consideree surtout au point de vue des symptomes ophtalmologiques).** *Acta Ophthal.*, Vol. XVI, p. 279, 1938.

(6) **Bensten** and his associates discuss the pathology of the Sturge-Weber syndrome (facial naevus, glaucoma and central nervous system disturbances from calcified cerebral angiomata) and report three cases observed by them. In addition to the classical features, one patient had homonymous hemianopia, and another showed complete ophthalmoplegia in one eye and internal ophthalmoplegia in the other.

ARNOLD SORSBY.

(7) **François, J. (Charleroi).—Haemorrhagica angiomatosa of family type and its ocular complications. (L'angiomatose hémorrhagique familiale et ses complications oculaires).** *Arch. d'Ophtal.*, Tome 2, p. 425, 1938.

(7) After referring to the three characteristics of the disease as described by Rendu-Osler:—telangiectasis, accidental haemorrhages, and the characteristic family history, **François** points out that the disease is quite distinct from haemophilia, and goes on to describe the case of a woman of 74 who suffered from this disease complicated by many ocular affections including telangiectasis of the eye-lids and cataract of the left lens.

F. R. HILL.

(8) **Bietti, G. (Rome).—Familial retinitis punctata albescens associated with "dystrophia marginalis cristallinea corneae," synchisis scintillans and other degenerative ocular changes. (Ueber familiäres Vorkommen von "Retinitis punctata albescens." Verbunden mit "Dystrophia marginalis cristallinea corneae," Glitzern des Glaskörpers und anderen degenerativen Augenveränderungen").** *Klin. Monatsbl. f. Augenheilk.*, Vol. XCIX, p. 738, 1938.

(8) **Bietti** describes an examination of 29 members of a family in which this combination of ocular defects occurred. The family also contained 4 cases of albinism and two of defective colour vision. The condition of the vitreous, the characteristic appearance of the white spots in the retina and the crystalline deposits in the cornea, suggest a lipoid degeneration. Three cases showed a definite hypercholesterinaemia. Hemeralopia was not a marked feature, there was slight retinal pigmentation in two cases only.

D. R. CAMPBELL.

(9) **Von Bahr, G. (Upsala):—A case of uveo-parotitis with perivasculitis and other rare symptoms.** *Acta Ophthal.*, Vol. XVI, p. 101, 1938.

(9) **Von Bahr** reports a case of uveo-parotitic fever showing all classical features, but in addition with two features of interest: (1) changes simulating kerato-conjunctivitis sicca from involvement of the lacrymal glands. (2) Perivasculitis affecting the veins which proved transient and did not all suggest tuberculosis; there were no serious fundus lesions so frequently reported in this affection.

ARNOLD SORSBY.

(10) **Graf, K. (Lwów).—Chronic intermittent oedema of the cornea as an angioneurosis. (Chronisches intermittierendes Hornhautödem als Ausdruck einen Angioneurosis).** *Zeitschr. f. Augenheilk.*, Vol. XCI, p. 278, 1936.

(10) **Graf** recalls that about 13 cases of recurrent chronic oedema of the cornea have been reported, all showing a suddenly developed oedema of the cornea interfering with vision and sometimes giving rise to the subjective phenomenon of coloured haloes. In most cases the onset is in the morning, and the symptoms disappear as suddenly as they begin. In no case was there any evidence of glaucoma or of any other eye disease. The condition is painless, but the patient may experience a sensation of heat in the eye. The slit-lamp reveals central oedema of the cornea, endothelial changes and increased visibility of the corneal nerve filaments. The author reports two further cases; both showed eosinophilia of the blood and chemical changes suggestive of disturbed hepatic function. He suggests that a toxic substance damages the endothelium allowing the aqueous to invade the cornea. The presence of excessive sweating and pain of the intermittent claudication type suggest an angioneurosis.

ARNOLD SORSBY.

(11) **Gardilčić, A. (Zagreb).—Ciliary perineuritis and periarteritis in a fresh case of herpes zoster ophthalmicus. (Perineuritis und periarteritis ciliaris bei einem frischen Fall von Herpes zoster Ophthalmicus).** *Zeitschr. f. Augenheilk.*, Vol. XCII, p. 35, 1937.

(11) **Gardilčić** recalls Meller's studies on herpes zoster ophthalmicus which showed that infiltrates invade the eye along the ciliary nerves. From the histological study of an eye excised because of the development of an hypopyon ulcer during the course of an attack of herpes zoster ophthalmicus, the author stresses the spread of infiltrates along both the posterior ciliary arteries and ciliary nerves. These could be easily demonstrated in the posterior segment of the

eye, whilst in the anterior segment the secondary changes following the hypopyon dominated. The infiltrates were characteristic and could be demonstrated in the choroid and sclera.

ARNOLD SORSBY.

III.—CATARACT

(1) **Rollin, J. L. (Hamburg).—Cataract in neurodermatitis. (Katarakt bei Neurodermia).** *Zeitschr. f. Augenheilk.*, Vol. XCII, p. 16, 1937.

(1) **Rollin** reports cases of cataract in two patients aged 31 and 30 years respectively, the subjects of neurodermatitis (chronic lichen simplex). In both cases the lens opacities were subcapsular. In one patient hypofunction of the thyroid could be demonstrated; in the second there was asthma (a not uncommon association of the disease) raising the question of an allergic basis.

ARNOLD SORSBY.

(2) **Bücklers, M. (Berlin).—Filiform cataract. (Kataracta filiformis).** *Zeitschr. f. Augenheilk.*, Vol. XCI, p. 338, 1936.

(2) **Bücklers** describes a hitherto unrecognised type of familial cataract. The whole lens becomes swollen and converted into a mass showing large water clefts and a filiform arrangement of the disorganized lens matter, taking, here and there, the shape of whorls. His patients were a brother and sister, in whose antecedents consanguineous marriages were frequent.

ARNOLD SORSBY.

(3) **Fischer, F. P. (Utrecht).—On the presence of vitamin B. in the lens and its signification. (Sur la presence de vitamine B dans le cristallin et sa signification).** *Arch. d'Ophtal.*, Tome 2, No. 2, p. 108, 1938.

(3) **Fischer** discusses the composition of the lens and as a result of investigations he states that that the normal lens contains:—

No thiochrome.

Some vitamin B.

The cataractous lens contains:—

No vitamin B.

The amount of "pyruvic" acid increases in direct proportion to the density of the cataract.

FRANCIS R. HILL.

IV.—NEUROLOGY

(1) **Vail, Derrick (Cincinnati). — Optochiasmic arachnoiditis.** *Arch. of Ophthal.*, September, 1938.

(1) **Vail's** article opens with the account of a case of this disease in which failing vision occurred seven years after a head injury. The fields showed evidence of a suprasellar lesion and operation disclosed pial-arachnoid adhesions around the anterior part of the chiasma and optic nerve with loculations of cerebro-spinal fluid. The adhesions were freed and the patient made a good recovery, vision improving from counting fingers to 20/30 within a period of 18 months. The cause of arachnoiditis is not yet definitely established, though it is probably antecedent trauma or possibly an infection from the posterior nasal sinuses. Adhesions form as a result of these causes with consequent accumulation of cerebro-spinal fluid and production of pressure symptoms which of course vary according to the locality affected. When this is in the chiasmal region a fairly definite syndrome may be produced and analysis of 134 cases has allowed the author to draw the following conclusions :—80 per cent. occur under the age of 40, and 7 have been reported under the age of 10. The vision in one eye may be affected long before the other—in one case, there was 10 years interval. Once the disease begins however, loss of vision is likely to be rapid though occasionally there are remissions. The earliest signs and symptoms are frequently those of retrobulbar neuritis but various combinations can occur. (1) Unilateral central scotoma with normal fundi or with pallor of the affected disc. (2) Bilateral central scotoma with pallor or oedema of both discs. (3) Blindness from pressure atrophy of one optic nerve with papilloedema in the fellow eye and perhaps a central scotoma. (4) Various alterations of the peripheral fields may be superadded to the central changes, *e.g.*, bitemporal, binasal or homonynous hemianopia. A condition of the disc in which there is pallor, a visible lamina cribrosa, a clear margin but marked reduction in calibre of the vessels is strongly suggestive of arachnoiditis. In most cases the cerebro-spinal fluid is normal and ventriculography is of no value in diagnosis. This, therefore, presents many difficulties but is important because of the improvement which may follow appropriate surgical treatment.

F. A. W-N.

(2) **Th. Alajouanine and Morax, Pierre V.—The tonic pupil (pupillotony) and its relation to Adie's syndrome. (La pupille tonique (pupillotonie) et ses rapports avec le syndrome d'Adie).** *Ann. d'Ocul.*, Vol. CLXXV, March, 1938, p. 205, and April, 1938, p. 277.

(2) **Alajouanine** and **Morax** have observed nine cases of Adie's syndrome. They provide a monograph on this much discussed

subject based on their own cases and ninety-two cases recorded in the literature.

The syndrome has been characterised by the association of a tonic pupil with partial or complete absence of the tendon reflexes and with sympathetic disturbances. There is usually no evidence of a syphilitic aetiology.

The tonic pupil appears at an early age; it is in most of the cases unilateral, and it is commoner in the female sex. Headaches, migraine and diminished power of accommodation may constitute the prodromal symptoms. Sometimes pains in the legs are present, which, however, cannot be compared with the lightning pains of tabes. Usually, the tonic pupil is mydriatic. The pupil of all the cases, which the authors have seen, was of an irregular shape. The light reflex seemed to be abolished in all cases, in reality an extremely sluggish reaction could be observed in five cases. In one of the cases, it could be elicited only after a preliminary wait in the dark room. In two cases of bilateral tonic pupil a one-sided paradoxical dilatator response to light could be seen. The tonic pupil did not show a consensual reaction. Tonic contraction and sluggish relaxation of the sphincter pupillae were present in all cases; all were of the myotonic type and none of the neurotonic type, which shows tonic reaction to light and a normal behaviour of the pupil in convergence. An important point of difference between the tonic and the Argyll Robertson pupil is to be found in the ready or even exaggerated reaction of the former to mydriatics and miotics. A tonic accommodation has not been seen by the authors, though in 18 per cent. of the cases recorded in the literature this symptom has followed the appearance of a tonic pupil. Slight ptosis was present in two cases. The tendon reflexes are usually not completely abolished, often they are not absent at all, sometimes only one or both tendo-Achilles' reflexes cannot be elicited. In one of the author's cases the Wassermann reaction of the C.S. fluid was positive, while the reaction of the blood was negative. All the other cases proved to be serologically negative. The general health of the patients was satisfactory apart from a certain nervousness and sympatheticotonic disorders of the female patients. The authors are of opinion, that in 22 per cent. of all recorded cases a mild syphilitic infection is present though the serological examinations had a negative result. Of their own nine cases, syphilis was certainly present once, practically certain in another case, and probable in two cases.

The authors have come to the same conclusion as Kehrer in his monograph on this subject: Adie's syndrome is not a clinical unit, and cannot be referred to a general sympathetic disorder. In most of the cases the tonic pupil is the final or intermediary stage of different pupillary disorders. Ten per cent. of the tonic pupils are

the outcome of internal ophthalmoplegia. On the other hand, the tonic pupil may resemble an atypical Argyll Robertson pupil, and eventually assume the character of the typical tabetic pupil.

HUMPHREY NEAME.

(3) **Moore, Woods, Hopkins and Sloan (Baltimore).—The treatment of syphilitic primary optic atrophy.** *Jl. Amer. Med. Assoc.*, July 30, 1938.

(3) While there is no concensus of opinion as to the pathology or the treatment of syphilitic primary optic atrophy there is general agreement on two points, firstly that the untreated condition always involves both eyes, and secondly that eventually blindness results, which is permanent and complete.

The authors present the results of treatment of 191 patients who were all personally observed and were indubitable examples of ophthalmologically uncomplicated syphilitic primary optic atrophy. They find that blindness may be expected to occur within one year in 32 per cent., within two years in 50 per cent., and within four years in 75 per cent. Blindness is defined as central visual acuity of 10/200 (*i.e.*, 3/60) or less in the better eye. To be regarded as successful, any form of treatment must delay the development of blindness in a significant proportion of cases, or prevent it beyond the seventh year or, when the atrophic process begins as monocular, prevent the onset of atrophy in the uninvolved eye.

The clinical material was grouped as follows:—65 patients received no treatment; 28 patients received inadequate antisyphilitic treatment; 34 patients received adequate routine treatment, *i.e.*, more than ten injections each of an arsenical and a heavy metal; 28 patients initially had one or more subdural intraspinal or intracisternal injections of arsphenaminized serum, accompanied or followed by routine antisyphilitic treatment; 9 patients were treated initially by induced malaria followed by routine treatment; 27 patients were treated by a combination of two or more of these systems.

The authors' experience indicates that the trivalent arsenical drugs and the heavy metals do not possess any direct toxic affinity for the optic nerve (as do the pentavalent arsenicals such as tryparsamide); that in about 10 per cent. of the patients treated the subdural method does carry a risk of sudden blindness; and that malaria exercises no deleterious effect.

Their conclusions are as follows:—Inadequate routine antisyphilitic treatment in no way influences the onset of blindness; adequate routine treatment seems to delay or even occasionally to arrest the atrophic process; malaria therapy permenantly arrests optic atrophy in a high percentage of cases; if treatment is begun

while optic atrophy is unilateral, involvement of the normal eye may be prevented in a high proportion.

The initial form of treatment should be induced malaria followed by intensive and prolonged routine antisyphilitic treatment with trivalent arsenical drugs, bismuth compounds and mercury.

A. F. MACCALLAN.

NOTES

Honour

MR. L. VERNON CARGILL has been elected Fellow of King's College, London.

* * * *

White Oak Hospital, Swanley

DURING 1938, 607 children were admitted to the hospital. This number includes 93 children re-admitted during the year after transfer for some other treatment at another institution, and 36 admitted the year before and similarly re-admitted. The total number of new admissions was, therefore, 478. The following table gives the distribution according to affection.

Blepharitis	248
Phlyctenular ophthalmia	120
Squint	28
Chronic conjunctivitis	21
Corneal ulcer	14
Interstitial keratitis	12
Trachoma	10
Keratitis	7
Recurrent styes	6
Iridocyclitis	5
Discharging socket	2
Other conditions	5

* * * *

Ophthalmological Society of Egypt

THE Annual Congress of the Ophthalmological Society of Egypt took place at the Memorial Ophthalmic Laboratory, Giza, on March 24, 1939. The symposium for the said Congress was non-suppurative keratitis.

National Society for the Prevention of Blindness, Inc.

MISS ELIZABETH G. GARDINER has been appointed to the staff as Medical Social Worker. She is a former President of the American Association of Medical Social Workers and has served as Exchange Lecturer at the University of Liverpool.

* * * *

International Association against Trachoma. Corrigendum

THE Annual Scientific Meeting will be held on Friday, April 21, at 8.30 p.m., at the Royal Society of Medicine.

The subject for discussion and the names of the openers were given on p. 221. Members of the Congress are invited to attend.

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North of England Ophthalmological Society. 1939-1940

AT the Annual Meeting of the North of England Ophthalmological Society held on March 3, 1939, the following members were elected to the Council for the year 1939-1940:—President: Mr. A. MacRae; Vice-President: Mr. E. F. Wilson; Treasurer: Mr. W. H. Kiep; Members of Council: Mr. D. Stenhouse Stewart and Mr. A. E. P. Parker; Secretary: Mr. Percival J. Hay.

FUTURE ARRANGEMENTS

1939

April 20-22.—Ophthalmological Society of the United Kingdom, Annual Congress, at the Royal Society of Medicine.

May 4-5.—Irish Ophthalmological Society, Dublin.

May 19.—Midland Ophthalmological Society, at Gloucester Royal Infirmary and Eye Institution.

June 9.—Section of Ophthalmology, Royal Society of Medicine. (Annual.)

July 6-8.—Oxford Ophthalmological Congress, at Oxford.

October 6.—Midland Ophthalmological Society, at Birmingham and Midland Eye Hospital. (Annual.)

CONTEMPORARY OPHTHALMIC LITERATURE

Archives of Ophthalmology. *January, 1939.*

WHEELER. Correction of ptosis by attachment of strips of orbicularis muscle to the superior rectus muscle.

DUTT. Rôle of nonviolence in lever action intracapsular extraction of cataract.

NEHER. A new method of transplanting pterygium.

HEATH and GEITER. Some physiologic and pharmacologic reactions of isolated iris muscles.

CASSADY. Congenital cyst of the vitreous.

GREEN. Ocular manifestations in brucellosis (undulant fever).

PINKERTON. Malignant melanoma of the choroid with metastases: report of a case.

FERREE and RAND. Higher visibility in a roentgenogram illuminator.

GUNDERSEN. Vascular obliteration for various types of keratitis; its significance regarding nutrition of corneal epithelium.

PERERA. Congenital grouped pigmentation of the retina: report of a case.

CUSICK and HERRELL. Retinal arteriolar changes as part of an induced general vasospastic reaction: effect of tobacco and cold.

KOCH. Herpes zoster ophthalmicus: report of a case.

February, 1939.

GIFFORD and MARQUARDT. Central angiospastic retinopathy.

THYGESON with the technical assistance of NANCY ROBERTS. Cultivation of trachomatous conjunctival epithelium in vitro.

HOUWER. Pecularities of well-known ocular diseases in the Netherland East Indies.

SANDERS. Mixed tumour of the lacrymal gland.

DIMITRY. Evolution of a sucking disk for intracapsular extraction of cataract.

BENDER and WEINSTEIN. Dissociated monocular nystagmus with paresis of horizontal ocular movements.

SAMUELS. Pathologic picture of retinal detachment: a survey.

ECKARDT and JOHNSON. Nutritional cataract and relation of galactose to appearance of senile suture line in rats.

GREEN, A. S., and GREEN, M. I. Automatic trephine for glaucoma.

BARKAN. An operative procedure for glaucoma of shallow chamber type: multiple excisions of the root of the iris and deepening of the anterior chamber.

GIFFORD and BELLOWS. Histologic changes in the lens produced by galactose.

Annales d'Oculistique. *January, 1939.*

JAYLE. Contribution to the study of acquired spasms of the levator muscle of the upper eyelid.

MONTPELLIER, TOULANT and FOISSINI. Ganglio-neuro-schwanno-spongioblastoma of the orbital cavity.

ANDRADE. Studies on trachoma.

February, 1939.

WEEKERS. Treatment of ocular affections by orbital injections of alcohol.

CORNET. True and false papillary conjunctivitis.

DOESSCHATE and FISCHER. Optical illusions provoked by a revolving light.

Revista Oto-Neuro-Oftalmologica. *December, 1938.*

MANOLESCO, LAZARESCO and VINTILESCO. Naevus flammeus, cerebral angioma and glaucoma.

Archiv. für Ophthalmologie. *February, 1939.*

PISA. Binocular visual space in domestic animals.
SCHUBERT. Aniseikonia.
ZAFFKE. Normal curves of dark adaptation in absolute threshold stimulus value with Birch-Hirschfeld's perception of light test.
KINUKAWA and MATSUDA. Clinical and experimental researches by means of caterpillar hair filament producing alterations of the fundi.
CAROW. Researches on the near upward and downward movements of the eye.
EULER, HELLSTROM, SCHLENK and GÜNTHER. The enzyme system of oxide reduction metabolism in the lens.
LEYDHECKER. History of ophthalmology.
SUGITA. Further studies on the nature of the disc-like or ring-shaped corneal opacities of keratitis disciformis and other forms of keratitis.
GRÓSZ. Significance of vitamin B in ophthalmology.
MÜLLER. The carbohydrate metabolism of the lens in acute naphthalene poisoning.
WAGNER. Remarks on Bakker's attack on ultra-red cataract.

Klinische Monatsblätter für Augenheilkunde. *January, 1939.*

POSTHUMUS. Megalocornea in connection with other anomalies in members of the same family.
KAYSER. The impossibility of genetic connection between macrocornea, megalocornea and hydrophthalmos.
FRIEDE. Congenital entoderm-mesoderm-hypoplasia of the eyes and its relation to cornea plana congenita.
VOGT. A further histological picture of wave folds of the parenchyma lamella of the keratoconical apex.
KLAR. Observations and researches on the diffusion of fluorescein in human and animal eyes.
SPYRATOS. A contribution to ocular angioscopy.
COMBERG. Iris agglutination from operation and a small instrument for iris reposition.
BERGLER. Trepanation-cyclodialysis.
CZUKRÁSZ. Mechanical ocular injuries.
NIZETIC. Restoration of the lacrymal passage.
NIZETIC. Bilateral dacryocystorhinostomy. A contribution to the operative therapy of suppurating lacrymal passages.
MEYER. Ocular tuberculosis and benign lymphogranulomatosis.
REMELÉ. The value of gold preparations Solganal B oleosum for the treatment of ocular tuberculosis.
ZAVALIA and OLIVA. Corneal chrysosis in the course of sanocrysin treatment.
LISCH. Share of the eyeball in general chrysosis.

Rassegna Italiana d'Ottalmologia. *September-October, 1938.*

SGROSSO. Contribution to keratoplasty.
VENCO. Some technical points in external dacryocystorhinostomy.
BOSA. The PH of the aqueous and lens in animals after the removal of the parathyroids.
RUATA. Rickettsiosis and trachoma.
ANGIUS. Ocular lesions from the juice of the spurge.
MATHIS. Research on the bacteriology of the conjunctival secretion of rabbits suffering from myxomatosis.